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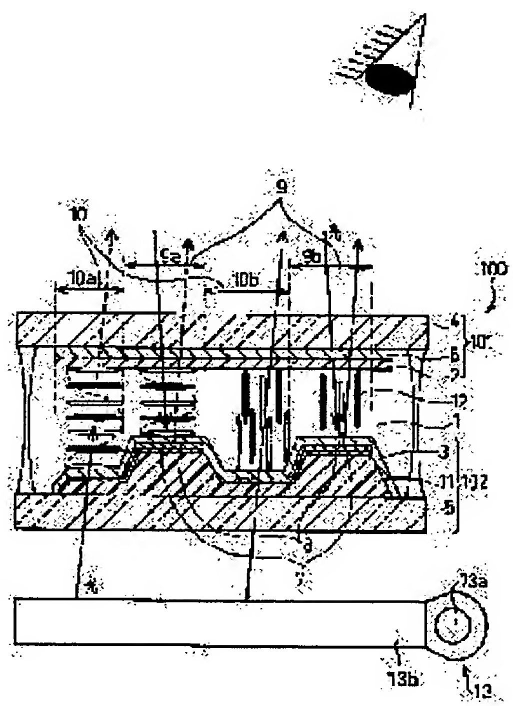
(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To improve visibility, to perform high resolution display and to utilize both reflected light and transmitted light for display.

SOLUTION: This liquid crystal display device is provided with a light crystal display element 100 provided with a pair of substrates 4 and 5 where alignment layers and 3 are formed on surfaces facing each other and a liquid crystal layer 1 clamped between the pair of the substrates 4 and 5. In this case, an orientation mechanism for making optional and different areas utilized for the display in the liquid crystal layer simultaneously take at least two kinds of different alignment states is provided. Also, a reflection film 8 is arranged in at least one of the areas for indicating the different alignment states in the liquid crystal layer 1 and the area for indicting the different alignment state is used for a reflection display part 9 for performing reflection display and a transmission display part 10 for performing transmission display. As the alignment mechanism, for instance, the alignment layers 2 and 3 subjected to alignment layer treatment in the different orientation for the reflection display part 9 and the transmission display part 10 and an insulation film 11 formed into different film thickness for the reflection display part 9 and the transmission display part 10, etc., are cited.



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CLAIMS

[Claim(s)]
[Claim 1] The substrate of the couple by which the orientation means was given to the front face which counters. The liquid crystal display element which has the liquid crystal layer pinched between the substrates of this couple. Are the liquid crystal display equipped with the above, and it is arbitrary and the orientation mechanism for making it simultaneously take at least two kinds of different orientation states is provided to a different field used for the display in the above-mentioned liquid crystal layer. And a reflective means is allotted to at least one field among the fields which show a different orientation state in the above-mentioned liquid crystal layer, and the field which shows an orientation state different the account of a top is characterized by being used for the reflective display which performs a reflective display, and the transparency display which performs a transparency display.
[Claim 2] The liquid crystal display according to claim 1 characterized by the above-mentioned orientation mechanism being the content rewriting means of a display which rewrites the content of a display in connection with the passage of time.
[Claim 3] The substrate of the couple by which the orientation means was given to the front face which counters. The liquid crystal display element which has the liquid crystal layer pinched between the substrates of this couple. It is the liquid crystal display equipped with the above, and while each field where the field used for the display in the above-mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display, a reflective means is allotted to a reflective display at least, and it carries out that the liquid crystal thickness of the above-mentioned reflective display is smaller than a transparency display as the feature.
[Claim 4] A liquid crystal display given in any 1 term of the claims 1-3 characterized by giving the orientation means to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in one [at least] substrate among the substrates of the above-mentioned couple so that at least two kinds of different directions of orientation may be given to the orientation of the liquid crystal layer interface which touches it.
[Claim 5] A liquid crystal display given in any 1 term of the claims 1-4 to which the rate for which the area of the reflective display to the area of the sum total with the above-mentioned reflective display and a transparency display accounts is characterized by being 30% or more and 90% or less.
[Claim 6] A liquid crystal display given in any 1 term of the claims 1-5 to which a reflective display is characterized by a dark display and the bird clapper simultaneous [when the above-mentioned transparency display is the Ming display, a reflective display serves as the Ming display simultaneously, and] when the above-mentioned transparency display is a dark display.
[Claim 7] A liquid crystal display given in any 1 term of the claims 1-6 characterized by the bird clapper from the liquid crystal constituent with which the above-mentioned liquid crystal layer comes to mix in liquid crystal the coloring matter which has dichroism.
[Claim 8] A liquid crystal display given in any 1 term of the claims 1-7 characterized by arranging the polarizing plate among the substrates of the above-mentioned couple at the non-contact side side with the liquid crystal layer in one [at least] substrate.
[Claim 9] It has a voltage impression means to impress voltage to the above-mentioned liquid crystal layer. this voltage impression means The phase contrast of the display light on the reflective means of the reflective display at the time of voltage impression The liquid crystal display according to claim 8 characterized by impressing voltage so that the phase contrast of the display light which serves as a difference among 90 degrees in general in the time of the Ming display and a dark display, and carries out outgoing radiation of the liquid crystal layer in a transparency display may serve as a difference among 180 degrees in general in the time of the Ming display and a dark display.
[Claim 10] The liquid crystal display according to claim 8 or 9 with which the above-mentioned liquid crystal layer is

characterized by carrying out twist orientation on the twist square of 60 degrees or more and 100 degrees or less between the substrates of the above-mentioned couple.
[Claim 11] The liquid crystal display according to claim 8 or 9 with which the above-mentioned liquid crystal layer is characterized by carrying out twist orientation on the twist square of 0 times or more and 40 degrees or less between the substrates of the above-mentioned couple.
[Claim 12] The above-mentioned liquid crystal display element is a liquid crystal display given in the claims 1-6 which are at least one side among the above-mentioned reflective display and a transparency display, and are characterized by displaying by changing the orientation state of a liquid crystal layer by rotating a liquid crystal molecule in parallel to a substrate, and any 1 term of 8 or 9.
[Claim 13] The above-mentioned liquid crystal display element is a liquid crystal display according to claim 12 characterized by equipping the above-mentioned liquid crystal layer with a voltage impression means to make the field inboard of a substrate produce electric field, among the above-mentioned reflective display and a transparency display corresponding to either.
[Claim 14] It is a liquid crystal display given in the claims 1-9 characterized by one [at least] substrate equipping the field at least corresponding to one side with the orientation film which has a perpendicular stacking tendency among the above-mentioned reflective display in the contact surface with the above-mentioned liquid crystal layer, and a transparency display among the substrates of the above-mentioned couple, and any 1 term of 12 or 13.
[Claim 15] It is a liquid crystal display given in any 1 term of the claims 1-14 to which one [at least] substrate equips the field corresponding to a reflective display with an insulator layer at least among the above-mentioned reflective display and a transparency display among the substrates of the above-mentioned couple, and it is characterized by forming this insulator layer so that the direction of the field corresponding to the above-mentioned reflective display in the thickness may become thicker than the field corresponding to a transparency display.
[Claim 16] To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple The field corresponding to a reflective display at least among the fields which the light filter which has transparency color is allotted, and constitute the above-mentioned viewing area in part A liquid crystal display given in any 1 term of the claims 1-15 characterized by allotting the light filter allotted to the field corresponding to the transparency display in the above-mentioned substrate, and the light filter which has the same lightness.
[Claim 17] To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple The field corresponding to a reflective display at least among the fields which the light filter which has transparency color is allotted, and constitute the above-mentioned viewing area in part A liquid crystal display given in any 1 term of the claims 1-15 characterized by allotting the light filter which has transparency color with lightness higher than the light filter allotted to the field corresponding to the transparency display in the above-mentioned substrate.
[Claim 18] A liquid crystal display given in any 1 term of the claims 1-17 characterized by setting at least the area of the field which the light filter which has transparency color is allotted, and does not perform the color display of a reflective display according to the luminous transmittance of the transparency color of the above-mentioned light filter as the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple.
[Claim 19] A liquid crystal display given in any 1 term of the claims 1-15 characterized by allotting the light filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple.
[Claim 20] The liquid crystal display according to claim 19 characterized by setting up the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of the transparency color of the above-mentioned light filter.
[Claim 21] To the field corresponding to a reflective display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple The field corresponding to a transparency display at least among the fields which the light filter which has transparency color is allotted, and constitute the above-mentioned viewing area in part A liquid crystal display given in any 1 term of the claims 1-15 characterized by allotting the light filter allotted to the field corresponding to the reflective display in the above-mentioned substrate, and the light filter in which saturation has the transparency color more than equivalent.
[Claim 22] A liquid crystal display given in any 1 term of the claims 1-21 characterized by serving as a screen brightness change means by which have the lighting system which carries out incidence of the light to the above-mentioned liquid crystal display element from the tooth back of this liquid crystal display element, and this lighting system changes the brightness of the screen.

[Claim 23] The above-mentioned lighting system is a liquid crystal display according to claim 22 characterized by changing the brightness of the screen according to adaptation luminance so that consciousness lightness may be set to 10 or more brils and less than 30 brils.
[Claim 24] A liquid crystal display given in any 1 term of the claims 1-23 characterized by providing a press coordinate detection blocking force means to detect the coordinate position pressed when it was arranged in piles and pressed by the screen.
[Claim 25] It is the liquid crystal display according to claim 22 or 23 characterized by providing a press coordinate detection blocking force means to detect the coordinate position pressed when it was arranged in piles and pressed by the screen, interlocking with [output signal / of the above-mentioned press coordinate detection blocking force means] the above-mentioned lighting system, and changing the brightness of the screen.
[Claim 26] It is the liquid crystal display according to claim 1 or 2 characterized by providing a press coordinate detection blocking force means to detect the coordinate position pressed when it was arranged in piles and pressed by the screen, interlocking with [output signal / of the above-mentioned press coordinate detection blocking force means] the above-mentioned orientation mechanism, and changing the orientation state of the liquid crystal layer at least in one side among the above-mentioned reflective display and a transparency display.
[Claim 27] A liquid crystal display given in any 1 term of the claims 1-26 characterized by providing the press coordinate detection blocking force means and polarizing plate which detect the coordinate position pressed when it was arranged in piles and pressed by the screen, and arranging the above-mentioned polarizing plate, the press coordinate detection blocking force means, and the liquid crystal display element at this order.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the liquid crystal display used especially in more detail in the intense environment of change of the liquid crystal display with which the outdoors and indoor are used, an automobile, the aircraft, a vessel, etc. of lighting environment about the liquid crystal display used for information machines and equipment, such as a word processor and a notebook sized personal computer, various visual equipments and a game machine machine, carried type VCR, a digital camera, etc.
[0002]
[Description of the Prior Art] Conventionally, the cathode-ray tube (CRT;Cathode Ray Tube), an electroluminescence (EL;ElectroLuminescence) element, a plasma display panel (PDP;Plasma DisplayPanel), etc. are electrically put in practical use as spontaneous light type display which can rewrite the content of a display.
[0003] However, in order for spontaneous light type display to make the display light itself emit light and to use it for a display, it has the trouble that power consumption is large. Furthermore, since the luminescence side of spontaneous light type display is the screen which has a high reflection factor in itself, when spontaneous light type display is used, compared with luminescence brightness, the so-called washout phenomenon in which it becomes impossible to observe display light is not avoided in the situation, for example, the direct-rays lower etc., that an ambient light is strong of an operating environment etc.
[0004] On the other hand, the liquid crystal display is given to practical use as a color display which displays a character and a picture by adjusting the amount of transmitted lights of the light from the specific light source, without the display light itself emitting light. This liquid crystal display (LCD;Liquid Crystal Display) can be divided roughly into a penetrated type liquid crystal display and a reflected type liquid crystal display.
[0005] Among those, present especially the thing used widely is a penetrated type liquid crystal display using the light source called so-called background lighting (back light) to a background, i.e., the tooth back of a liquid crystal cell, as electrochromatic display display. Although it had the thin shape and the advantage of lightweight ** and the use is expanded in various fields, it is one of these, this penetrated type liquid crystal display consumes a lot of power in order to make background lighting (back light) emit light, and although there is little power used for the permeability modulation of liquid crystal, it requires comparatively big power.
[0006] However, in such a penetrated type liquid crystal display (namely, penetrated type electrochromatic display display), the washout phenomenon looked at by the aforementioned spontaneous light type display is reduced. This is because the reflection factor of the screen of the light-filter layer by which the object for facilities is carried out to penetrated type electrochromatic display display is reduced by the low reflection factor-ized technology of the light-filter layer using the black matrix etc.
[0007] However, even if it is the case where penetrated type electrochromatic display display is used, an ambient light is very strong, and when display light is weak, observation of display light becomes difficult relatively. For this reason, that such a trouble should be solved, if background lighting light is reinforced further, the problem of consuming more power will be invited.
[0008] Since a reflected type liquid crystal display displays using an ambient light to the above emitted type display of light, or a penetrated type liquid crystal display, the display light proportional to the amount of ambient lights can be obtained. For this reason, a reflected type liquid crystal display has the theoretic advantage of not causing the above-mentioned washout phenomenon, and can observe a display on the contrary more vividly in a very bright place where direct rays hit. furthermore, since a reflected type liquid crystal display does not need background lighting (back light) in the display, it can cut down the power for making background lighting (back light) emit light -- etc. -- it has the advantage For this reason, especially the reflected type liquid crystal display fits use on the outdoors, such as a

Personal Digital Assistant device, and a digital camera, a pocket video camera.
[0009] However, in the reflected type liquid crystal display of these former, in order to use an ambient light for a display, the degree for which display brightness depends on circumference environment is very high, and has the trouble that the content of a display cannot be checked, under the weak environment of an ambient light. When the light filter used in order to realize a color display (color display) especially is used, in order that a light filter may absorb light, a display becomes dark further. Therefore, in such a case, the above-mentioned problem becomes much more remarkable.
[0010] Then, the lighting system called front light is developed as supplemental lighting so that a reflected type liquid crystal display can be used also under the weak environment of an ambient light. The reflecting plate is installed in the tooth back of a liquid crystal layer, and background lighting (back light) like a penetrated type liquid crystal display cannot be used for a reflected type liquid crystal display. For this reason, the lighting system (front light) used for a reflected type liquid crystal display illuminates a reflected type liquid crystal display from a front, i.e., the screen, side.
[0011] It considers as the liquid crystal display with which circumference lighting light, on the other hand, enables use under weak environment taking advantage of the advantage of a reflected type liquid crystal display, a part of incident light is penetrated, and the liquid crystal display using the so-called reflective film of semipermeability made to reflect the remaining incident light is put in practical use. Thus, generally the liquid crystal display using both the transmitted light and the reflected light is called transflective LCD.
[0012] For example, the transflective LCD which performs a lightness modulation to JP,59-218483,A (it corresponds to a Japanese-Patent-Application-No. No. 92885 [58 to] official report) using TN (Twisted Nematic) method and the liquid crystal display method which modulates transmitted light intensity, such as a STN (super twisted nematic) method, is indicated. Moreover, the transflective LCD with which the reflective film arranged by approaching a liquid crystal layer has semipermeability is indicated by JP,7-318929,A. Furthermore, the penetrated type liquid crystal display using the in plain switching method as technology of realizing a large angle of visibility is indicated by JP,6-160878,A.
[0013]
[Problem(s) to be Solved by the Invention] However, a transflective LCD given in JP,59-218483,A is a trouble (1) since the reflective film of semipermeability is arranged on the rear face of a liquid crystal cell, in view of the observer side, as shown below. And (2) It has.
[0014] That is, it is (1) first. Difficulty is followed on a setup of the lightness which influences the conspicuousness of a display. That is, when setting up the lightness of a transflective LCD according to the lightness in the case of performing a reflective display, it is necessary to set up this lightness highly in preparation for use on conditions which run short of ambient lights. However, if the permeability of the polarizing plate used in TN method in order to make lightness high is set up highly, in a transparency display, the contrast ratios which ** and are defined by the lightness of a dark display of the lightness of the Ming display will run short, and visibility will be worsened. Although it is desirable to set up this lightness so that a contrast ratio may be raised on the other hand when setting up the above-mentioned lightness according to the lightness in the case of performing a transparency display, in a reflective display, lightness runs short in this case, and visibility is worsened.
[0015] Moreover, (2) In a reflective display, in order to reflect the light which passes the liquid crystal layer pinched by the substrate by the reflective film in which it was prepared at the rear face of a liquid crystal cell and to observe a display, the parallax (double image) in a reflective display will be seen, the fall of resolution will be caused, and a high resolution display will be difficult.
[0016] Moreover, since the reflective film itself has semipermeability, the transflective LCD given in aforementioned JP,7-318929,A has the trouble that the optical design suitable for the reflective display and the transparency display is impossible.
[0017] Furthermore, although the in plain switching method currently indicated in aforementioned JP,6-160878,A is used for the penetrated type liquid crystal display, the liquid crystal orientation on the Kushigata electrode does not contribute to a display. When this electrode wiring is many, this is not because it is produced with a metal without a translucency, and is because liquid crystal orientation change is inadequate for a transparency display.
[0018] Then, the invention-in-this-application person etc. tried to apply the means of displaying used for the reflected type liquid crystal display which can suppress parallax to a transflective LCD that these technical problems should be solved. Specifically, it is (a). GH (guest host) method and (b) which arranged the liquid crystal constituent which mixed in the liquid crystal layer the coloring matter (dichroism coloring matter) which has dichroism It examined wholeheartedly using two methods of the reflected type liquid crystal display method (it is hereafter written as an one-sheet polarizing plate method) using one polarizing plate for a transflective display.
[0019] In addition, the above (a) And (b) In order to arrange on the occasion of examination of use of the means of

displaying which does not produce parallax as shown in two methods so that a reflective film may be ****(ed) in a liquid crystal layer, and to enable it to also use the transmitted light for a display in addition to the reflected light, a part for transparency opening was prepared in the reflective film.
[0020] Consequently, the trouble of further the following became clear. First, (a) By GH method, if the concentration of the dichroism coloring matter mixed in a liquid crystal constituent is adjusted so that it may be suitable for a reflective display, in a transparency display, although lightness is high, it runs short of contrast ratios, and cannot obtain a good display. On the other hand, if the concentration of the above-mentioned dichroism coloring matter mixed in a liquid crystal constituent is adjusted so that it may be suitable for a transparency display, although a good contrast ratio is obtained, by the reflective display, lightness cannot fall and a good reflective display cannot be obtained at a transparency display.
[0021] Moreover, (b) When using an one-sheet polarizing plate method for a transflective display, a polarizing plate etc. is further added to the tooth back of whether a setup of the voltage impressed to the liquid crystal orientation and liquid crystal thickness which determine an optical property, or the liquid crystal which drives them is set up according to a reflective display, and the screen, a transparency display is performed (two-sheet polarizing plate method), and two kinds of whether to set up to compensate for this transparency display can be considered.
[0022] First, the display in the transparency display at the time of setting liquid crystal thickness as the thickness suitable for the reflective display is explained. Outside the electric field of the liquid crystal layer at the time of setting up the liquid crystal layer suitable for the reflective display etc., the amount of change of the polarization state accompanying the orientation change by the place is a grade from which it goes and comes back to a liquid crystal layer, and sufficient contrast ratio is obtained, when the front, i.e., the light which carried out incidence through the liquid crystal layer from the screen side, carries out outgoing radiation to a screen side through a liquid crystal layer again. However, in this setup, the transparency display of the variation of the polarization state of the light which passed the liquid crystal layer is inadequate. For this reason, even if it installs the polarizing plate used only for a transparency display in the tooth back of a liquid crystal cell in addition to the polarizing plate installed in the observer, i.e., the screen, side of the liquid crystal cell used for a reflective display, in view of an observer side, display sufficient in a transparency display is not obtained. That is, when the orientation conditions of a liquid crystal layer are set as the orientation conditions (liquid crystal thickness, liquid crystal orientation, etc.) of a liquid crystal layer of having been suitable for the reflective display, even if lightness runs short or a transparency display is enough as lightness, the permeability of a dark display does not fall and sufficient contrast ratio for a display is not obtained.
[0023] If it furthermore explains to a detail, when performing a reflective display, the orientation state of the liquid crystal in the above-mentioned liquid crystal layer is controlled by voltage impressed to the above-mentioned liquid crystal layer so that 1/4 wave of phase contrast is given in general to the light which passes a liquid crystal layer only at once. If only the voltage modulation which gives 1/4 wave of phase modulation to the light which passes a liquid crystal layer is performed using the liquid crystal layer set up that such phase contrast should be given to the light which passes a liquid crystal layer and a transparency display is performed When fully reducing permeability in case a transparency display is a dark display, when a transparency display is the Ming display, the light of the intensity of an abbreviation half is absorbed with the polarizing plate by the side of the outgoing radiation of light, and sufficient Ming display is not obtained. Moreover, since lightness in case a transparency display is the Ming display is increased, if optical elements, such as a polarizing plate and a phase contrast compensating plate, are arranged, lightness in case a transparency display is a dark display will turn into lightness of the abbreviation 1/2 of the lightness at the time of the Ming display, and will become inadequate [the contrast ratio of a display].
[0024] Next, the display in the reflective display at the time of setting the orientation conditions of a liquid crystal layer as the conditions suitable for the transparency display is explained. When performing a reflective display in the liquid crystal layer suitable for the transparency display, the polarization state of the light which passes a liquid crystal layer only at once needs to control liquid crystal orientation by the voltage modulation to become irregular between two polarization states which intersect perpendicularly mostly. Here, two polarization states which intersect perpendicularly may be the two linearly polarized lights which have the plane of vibration which intersects perpendicularly, and it may be the circular polarization of light on either side, and a major-axis direction may intersect perpendicularly by two elliptically polarized light of the still more nearly same ovality, and the hand of cut of a photoelectrical community may be reversed. In order to realize the modulation of the polarization state between the combination of these two polarization states that intersect perpendicularly, it is necessary to carry out a voltage modulation so that 1/2 wave of phase contrast may be given to the transmitted light in a liquid crystal layer. Thus, when the polarization state of light becomes irregular between two polarization states which intersect perpendicularly, an operation of a polarizing plate and an operation of the phase contrast compensating plate used if needed can realize sufficient lightness and a sufficient contrast ratio in a transparency display by any case.

[0025] When the above-mentioned liquid crystal layer is set up that such control should be realized, however, in a transparency display While changing from the Ming display to a dark display only at once, it sets to a reflective display. When the orientation change means of liquid crystal is the same, the display of the same light and darkness cannot be realized -- change of a reflection factor becomes a dark display from the Ming display, and becomes the Ming display further -- (for example, when the thickness of a liquid crystal layer is the same and also drives initial orientation on the same and still more nearly same voltage). In addition, the above (a) - (b) The technical problem produced in a case is the same as that of aforementioned JP,7-318929,A also in the transflective LCD of a publication.
[0026] Moreover, since itself has the reflection nature to light, the press sensing input unit (touch panel) used for a liquid crystal display in piles has the trouble of being easy to worsen visibility, and it is remarkable in especially a reflected type liquid crystal display. [of the inclination]
[0027] Moreover, many are the light pipe structure of a plane, and the front light unit to which an ambient light improves the visibility of the reflected type liquid crystal display in dark environment has ****, while saying that visibility tends to get worse, since the contents of a display are observed over this light pipe.
[0028] this invention is made in view of the above-mentioned trouble, and the purpose is excellent in visibility, and a high resolution display is possible, and it is in offering the liquid crystal display which can use both the reflected light and the transmitted light for a display. Moreover, the further purpose of this invention is excellent in visibility, and high resolution color display is possible for it, and it is to offer the liquid crystal display which can use both the reflected light and the transmitted light for a display.
[0029]
[Means for Solving the Problem] The cause of the trouble of the above-mentioned conventional liquid crystal display finds out the conclusion that it is because the orientation of the liquid crystal layer in this time is similarly set up by the transparency display and the reflective display in any [of the above-mentioned GH method and a polarizing plate method] case, and the invention-in-this-application person etc. came to complete this invention, as a result of inquiring wholeheartedly that the above-mentioned purpose should be attained.
[0030] Here, the orientation of a liquid crystal layer shall show not only the orientation direction of an average of the liquid crystal molecule in a point with a liquid crystal layer but the coordinate dependency of the average orientation direction to the coordinate taken in the direction of a normal of the layer of a stratified liquid crystal layer.
[0031] Namely, the liquid crystal display according to claim 1 by this invention The substrate of the couple by which the orientation means (for example, orientation film) was given to the front face which counters in order to solve the above-mentioned technical problem, It is the liquid crystal display equipped with the liquid crystal display element which has the liquid crystal layer pinched between the substrates of this couple. the orientation mechanism (for example, the electrode which produces electric field which are arbitrary, give voltage which is different to a different field used for the display in the above-mentioned liquid crystal layer, or are different --) for making it take at least two kinds of different orientation states it being arbitrary and simultaneous to a different field used for the display in the above-mentioned liquid crystal layer The orientation film by which was arbitrary, and was respectively prepared in a different field used for the display in the impressed voltage or the above-mentioned liquid crystal layer, and orientation processing was carried out in at least two kinds of the different directions, Or the insulator layer and substrate which were formed so that it might have at least two kinds of different thickness in the field used for the display in the above-mentioned liquid crystal layer, A specific liquid crystal material, the liquid crystal layer structure formed so that it might drive respectively independently, A polarizing plate, phase contrast compensating plates, or those combination are provided. A reflective means (for example, a reflective film and a reflector) is allotted to at least one field among the fields which show a different orientation state in the above-mentioned liquid crystal layer. the account of a top And the reflective display to which the field which shows a different orientation state performs a reflective display, It is characterized by being used for the transparency display which performs a transparency display.
[0032] According to the above-mentioned composition, by having the orientation state where liquid crystal orientation differs simultaneously, in using coloring matter, such as dichroism coloring matter, for a display, when using the amount of absorption of light (absorption coefficient), and an optical anisotropy, it becomes possible to change the size of the amount of modulations of each optical physical quantity called phase contrast for every field where liquid crystal orientation differs. For this reason, according to the above-mentioned composition, the permeability or reflection factor based on a size of the amount of modulations of the optical physical quantity according to the orientation state of a liquid crystal layer can be obtained, and this becomes possible [setting up an optical parameter independently by the transparency display and the reflective display]. Therefore, according to the above-mentioned composition, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise visibility when the circumference is dark, good visibility can be acquired even when an ambient light is strong. For this reason, according to the above-mentioned composition, it excels in visibility, and a high resolution display is possible, and the transflective type liquid

crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0033] Furthermore, the liquid crystal display according to claim 2 concerning this invention is characterized by the above-mentioned orientation mechanism being the content rewriting means of a display which rewrites the content of a display in connection with the passage of time in the liquid crystal display according to claim 1, in order to solve the above-mentioned technical problem.
[0034] The liquid crystal display of the claim 1 above-mentioned publication can be obtained without according to the above-mentioned composition, the same means' being able to realize the content rewriting means of a display, and the above-mentioned orientation mechanism, and adding new composition. In this case, a possible thing cannot be overemphasized, even if it is various meanses by which it is used for voltage impression of the electric liquid crystal orientation control means used widely now, i.e., an electrode etc., in order to rewrite the content of a display in connection with the passage of time as an above-mentioned content rewriting means of a display by which it is used in order to take two or more states where liquid crystal orientation differed. Two or more fields which have the orientation state where liquid crystal orientation differs can be prepared in a liquid crystal layer by using an electrode which is different by the transparency display and the reflective display in this case, or changing the voltage itself by the transparency display and the reflective display.
[0035] Moreover, when the grade of the amount of modulations of each optical physical quantity, such as the amount of absorption of light and phase contrast by the optical anisotropy, is independently changed by the reflective display and the transparency display, Even when the direction of orientation of the liquid crystal by impression of voltage is almost the same in the whole field for using for the display of a liquid crystal layer, in the field in which the liquid crystal thickness of a liquid crystal layer differs, it has substantially the same operation as the case where the direction of orientation of a liquid crystal layer is changed in this field. Coloring matter, such as dichroism coloring matter, is used especially, in the polarizing plate method using GH method using the absorption of light, a birefringence, or a rotatory-polarization phenomenon, each of each phenomena of the absorption of light produced in a liquid crystal layer and a birefringence is phenomena accompanying propagation of light, and each phenomenon has relevance between the propagation distance of the light in a liquid crystal layer, and the grade of those phenomena. Furthermore, display light passes a liquid crystal layer twice by round trip in a reflective display, in order to pass a liquid crystal layer only at once in a transparency display, when liquid crystal orientation is almost the same and liquid crystal thickness is similarly set up by the reflective display and the transparency display, sufficient lightness or a sufficient contrast ratio are not obtained and the aforementioned technical problem is not solved.
[0036] Then, the liquid crystal display according to claim 3 concerning this invention The substrate of the couple by which the orientation means (for example, orientation film) was given to the front face which counters in order to solve the above-mentioned technical problem, It is the liquid crystal display equipped with the liquid crystal display element which has the liquid crystal layer pinched between the substrates of this couple. While each field where the field used for the display in the above-mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display A reflective means (for example, a reflective film and a reflector) is allotted to a reflective display at least, and liquid crystal thickness of the above-mentioned reflective display is characterized by being smaller than a transparency display.
[0037] According to the above-mentioned composition, the permeability or reflection factor based on a size of the amount of modulations of the optical physical quantity in a field which is different in liquid crystal thickness can be obtained, and this becomes possible [setting up an optical parameter independently by the transparency display and the reflective display]. Therefore, according to the above-mentioned composition, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise visibility when the circumference is dark, good visibility can be acquired even when an ambient light is strong. For this reason, according to the above-mentioned composition, it excels in visibility, and a high resolution display is possible, and the transflective type liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.
[0038] The liquid crystal display according to claim 4 concerning this invention In a liquid crystal display given in any 1 term of claims 1-3 in order to solve the above-mentioned technical problem It is characterized by giving the orientation means to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in one [at least] substrate among the substrates of the above-mentioned couple so that at least two kinds of different directions of orientation may be given to the orientation of the liquid crystal layer interface which touches it.
[0039] Thus, it is given to the interface on the substrate which touches for example, the above-mentioned liquid crystal layer in addition to the content rewriting means of a display shown, for example in the above-mentioned claim 2 as a means for having the orientation state where liquid crystal orientation differs simultaneously, and the orientation film

by which orientation processing was carried out so that at least two kinds of different directions of orientation might be given to the orientation of the liquid crystal layer interface which touches it can be used. By thus, the thing performed for the orientation means to the field on the contact surface in contact with the field used for the display of the above-mentioned liquid crystal layer in the above-mentioned substrate front face so that at least two kinds of different directions of orientation may be given to the orientation of the liquid crystal layer interface which touches it In the field to which the above-mentioned liquid crystal layer is [for using for the display in this liquid crystal layer] arbitrary at the time of voltage impression, and differ at it, at least two kinds of different orientation states can be shown simultaneously, and a reflective display and a transparency display can be performed in the field in which the orientation states in the above-mentioned liquid crystal layer differ.
[0040] In this case, both the orientation of the liquid crystal which determines an optical property, and the orientation change at the time of impressing voltage can be changed by changing the elevation angle to the substrate of liquid crystal orientation, and its azimuth, and it becomes possible to perform the display which was suitable for each display by the reflective display and the transparency display.
[0041] According to this invention, according to the means and orientation mechanism which were mentioned above, although a good display is realizable by both the reflective display and the transparency display The optimal ratio for performing a good display into the ratio of a reflective display and a transparency display exists by the displays for which it asks, such as whether a color display (color display) is performed or monochrome display is performed, it displays by indicating it a subject by reflective, or to display by indicating it a subject by transparency.
[0042] That is, in order that the liquid crystal display according to claim 5 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display given in any 1 term of claims 1-4, the rate for which the area of the reflective display to the area of the sum total with the above-mentioned reflective display and a transparency display accounts is characterized by being 30% or more and 90% or less.
[0043] Moreover, it is desirable for the contents of a display not to be reversed by the reflective display from a viewpoint and transparency display of visibility. If lighting environment changes or the contents of a display are reversed by the reflective display and the transparency display in a situation with difficult prediction of change of lighting environment, with the intensity of an ambient light, this is to change the contrast ratio of a display sharply, and change of such a contrast ratio will serve as the same phenomenon as a washout, and it will cause large aggravation of visibility from the point of visibility.
[0044] Then, it is very important that a reflective display displays the Ming display simultaneously when a transparency display is the Ming display, and a reflective display displays a dark display simultaneously when a transparency display is a dark display when securing visibility.
[0045] For this reason, in order that the liquid crystal display according to claim 6 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display given in any 1 term of claims 1-5, when the above-mentioned transparency display is the Ming display, a reflective display serves as the Ming display simultaneously, and when the above-mentioned transparency display is a dark display, the reflective display is simultaneously characterized by the dark display and the bird clapper.
[0046] Moreover, the liquid crystal display according to claim 7 concerning this invention is characterized by the bird clapper in the liquid crystal display given in any 1 term of claims 1-6 from the liquid crystal constituent with which the above-mentioned liquid crystal layer comes to mix the coloring matter which has dichroism at liquid crystal, in order to solve the above-mentioned technical problem.
[0047] According to the above-mentioned composition, the above-mentioned liquid crystal layer can rationalize the amount of absorption of light by the reflective display and the transparency display by the bird clapper from the liquid crystal constituent which comes to mix in liquid crystal the coloring matter which has dichroism.
[0048] Moreover, it is also effective to use the method which uses a birefringence and a rotatory-polarization phenomenon for a display by both the reflective display and the transparency display, using a polarizing plate as means of displaying for performing a good display.
[0049] For this reason, the liquid crystal display according to claim 8 concerning this invention is characterized by arranging the polarizing plate among the substrates of the above-mentioned couple at the non-contact side side with the liquid crystal layer in one [at least] substrate in the liquid crystal display given in any 1 term of claims 1-7, in order to solve the above-mentioned technical problem.
[0050] According to the above-mentioned composition, by the reflective display and the transparency display, a birefringence can be rationalized and a good display can be performed. In order to use a polarizing plate method for a reflective display and to secure sufficient display in a transparency display with the liquid crystal display of the claim 3 above-mentioned publication at this time, it is required not only for a screen side but the incidence side of the light of a transparency display to have a polarizing plate.

[0051] Moreover, in a reflective display, as for the variation of the phase contrast of the light from which the orientation change by the voltage of a liquid crystal layer is also hung down in the liquid crystal display of the claim 8 above-mentioned publication, it is desirable to set up so that it may be suitable for the light which goes and comes back to a liquid crystal layer, and to set up so that it may be suitable for the light which penetrates a liquid crystal layer in a transparency display, when changing a display.

[0052] For this reason, the liquid crystal display according to claim 9 concerning this invention In order to solve the above-mentioned technical problem, in a liquid crystal display according to claim 8, it has a voltage impression means (for example, electrode) to impress voltage to the above-mentioned liquid crystal layer. this voltage impression means The phase contrast of the display light on the reflective means of the reflective display at the time of voltage impression It is characterized by impressing voltage so that the phase contrast of the display light which serves as a difference among 90 degrees in general in the time of the Ming display and a dark display, and carries out outgoing radiation of the liquid crystal layer in a transparency display may serve as a difference among 180 degrees in general in the time of the Ming display and a dark display.

[0053] In this case, specifically, as are shown in a claim 10, and the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of the above-mentioned couple on the twist square of 60 degrees or more and 100 degrees or less or it is shown in a claim 11, as for the liquid crystal orientation in the above-mentioned liquid crystal layer, it is desirable that the above-mentioned liquid crystal layer is carrying out twist orientation between the substrates of the above-mentioned couple on the twist square of 0 times or more and 40 degrees or less.

[0054] Between the substrates of the above-mentioned couple, the above-mentioned liquid-crystal layer can use change of the polarization near the rotatory polarization according to the twist of the orientation of liquid crystal for a display in the liquid-crystal layer of a transparency display with constituting the above-mentioned liquid crystal display so that twist orientation may be carried out on the twist square of 60 degrees or more and 100 degrees or less, and it can use change of the polarization by control with the rotatory polarization and a retardation for a display in a reflective display.

[0055] Moreover, the above-mentioned liquid crystal layer can use both change of a retardation for a display also in the liquid crystal layer of a reflective display also in the liquid crystal layer of a transparency display between the substrates of the above-mentioned couple with constituting the above-mentioned liquid crystal display so that twist orientation may be carried out on the twist square of 0 times or more and 40 degrees or less.

[0056] Moreover, in a liquid crystal display given in the above-mentioned claims 1-6 and any 1 term of 8 or 9, even if orientation change of liquid crystal is only change of the direction in a field parallel to a substrate, sufficient display is possible for it.

[0057] Namely, the liquid crystal display according to claim 12 concerning this invention In a liquid crystal display given in claims 1-6 and any 1 term of 8 or 9 in order to solve the above-mentioned technical problem the above-mentioned liquid crystal display element It is characterized by displaying by changing the orientation state of a liquid crystal layer among the above-mentioned reflective display and the transparency display by rotating a liquid crystal molecule in parallel to a substrate at least by one side.

[0058] Furthermore, in this invention, the lowness of the efficiency for light utilization of an in plain switching method is conquerable by using positively for a display the insufficiency of the liquid crystal orientation leading to the low light transmittance which is the technical problem of the conventional in plain switching method as a reflective display.

[0059] That is, in order that the liquid crystal display according to claim 13 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display according to claim 12, the above-mentioned liquid crystal display element is characterized by equipping the above-mentioned liquid crystal layer with a voltage impression means to produce electric field in the field inboard of a substrate, among the above-mentioned reflective display and a transparency display corresponding to either.

[0060] Moreover, although the orientation of a liquid crystal layer may be parallel orientation that to a display used, it may be perpendicular orientation in which liquid crystal is carrying out orientation perpendicularly to the substrate. [than before] [more]

[0061] The liquid crystal display according to claim 14 concerning this invention In a liquid crystal display given in claims 1-9 and any 1 term of 12 or 13 in order to solve the above-mentioned technical problem one [at least] substrate among the substrates of the above-mentioned couple It is characterized by equipping the field at least corresponding to one side with the orientation film which has a perpendicular stacking tendency among the above-mentioned reflective display in the contact surface with the above-mentioned liquid crystal layer, and a transparency display.

[0062] Thus, the above-mentioned substrate is equipped with the orientation film which has a perpendicular stacking tendency, and there is an advantage to which the contrast ratio of a display becomes good in being the perpendicular

orientation in which liquid crystal is carrying out orientation perpendicularly to the substrate, and moreover, when performing a good display to the above-mentioned claims 1-9, and 12 or 13 in the liquid crystal display of a publication, it acts effectively.
[0063] Moreover, the liquid crystal display according to claim 15 concerning this invention In a liquid crystal display given in any 1 term of claims 1-14 in order to solve the above-mentioned technical problem One [at least] substrate equips the field corresponding to a reflective display with an insulator layer at least among the above-mentioned reflective display and a transparency display among the substrates of the above-mentioned couple. this insulator layer The thickness is characterized by being formed so that the direction of the field corresponding to the above-mentioned reflective display may become thicker than the field corresponding to a transparency display.
[0064] That is, the above-mentioned liquid crystal display has an insulator layer on one [which pinches a liquid crystal layer / at least] almost smooth substrate, this insulator layer is a field corresponding to a transparency display, it is formed so that thickness may become thin rather than the field corresponding to a reflective display, or the insulating layer is formed only in the field corresponding to a reflective display, and the insulator layer is not formed in the field corresponding to a transparency display.
[0065] According to the above-mentioned composition, the field used for the display in a liquid crystal layer can obtain easily the liquid crystal display (namely, liquid crystal display with which liquid crystal thickness differs by the reflective display and the transparency display) which has at least two kinds of different liquid crystal thickness.
[0066] Moreover, the above-mentioned insulator layer can be impressed to a liquid crystal layer without loss of the voltage which drives a liquid crystal layer by forming the electrode for a display in the field where it not only acts as an adjustment means of liquid crystal thickness, but the above-mentioned insulator layer touches a liquid crystal layer in a reflective display.
[0067] In this case, the film which has light reflex nature as a reflective means in the substrate by the side of the screen and the substrate by which opposite arrangement was carried out is formed. It is effective that the film which has this light reflex nature has concavo-convex structure as a mirror-plane nature prevention means of the reflective display which does not spoil resolution, without spoiling the display performance of a transparency display. The above-mentioned insulator layer can form easily the film which has the above-mentioned light reflex nature which has concavo-convex structure by having the membranous concavo-convex structure of having the above-mentioned light reflex nature, and the same concavo-convex structure.
[0068] Moreover, when performing color display using the liquid crystal display of this invention, the design of not only a liquid crystal layer but a light-filter layer important for coloring is important. According to examination of invention-in-this-application persons, there are two kinds of main use forms of a transflective type liquid crystal display.
[0069] By one usually mainly using a transparency display in use, and using a reflective display additionally Prevent the washout under the very strong lighting environment of an ambient light, and it compares with the emitted type display of light, or the liquid crystal display of only a transparency display. It is the use form which secures the large versatility of usable lighting environment and which indicates it a subject by transparency. another usually, in use, under the weak environment of lighting taking advantage of the property of reflective display that there is little power consumption By turning on and using the lighting system called so-called back light, it is the use form which secures the large versatility of usable environment like a previous use form and which indicates it a subject by reflective.
[0070] In a previous use gestalt (use gestalt which indicates it a subject by transparency), among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple, at least, it excels in visibility, and high resolution color display is possible and the liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered by allotting the light filter which has transparency color to the field corresponding to a transparency display.
[0071] And when performing color display in this way, especially the thing for which the light filter which has transparency color is allotted to a transparency display at least, and the light filter which allots the light filter which has the same lightness as the light filter of a reflective display allotted to the transparency display in part at least, not using a light filter to a reflective display, or has the high transparency color of lightness rather than it is allotted is effective in each pixel.
[0072] If the light filter of a transparency display is used for a reflective display as it is, when it will be because lightness runs short and a reflective display will also perform color display, this By allotting the light filter which establishes the field which does not use a light filter in a reflective display, or has the high transparency color of lightness rather than a transparency display in a reflective display It is because lightness is suppliable, color display becomes possible and a reflection factor required for a reflective display can be secured also to a reflective display.
[0073] And in a reflective display, if it takes into consideration that display light passes a light filter twice, it is

desirable to allot the light filter which has the high transparency color of lightness rather than a transparency display to a reflective display.

[0074] Moreover, in the use gestalt which indicates it a subject by transparency, when considering as the composition which has the field which does not prepare a light filter in a reflective display, a display voltage signal required for a transparency display is the signal for which it was suitable to the color display, and a display voltage signal required for a reflective display is the signal it was suitable to monochrome display in the example which is not used at all in a light filter to a reflective display. Therefore, although the rate which the pixel of each color contributes to lightness when considering as the composition which does not prepare a light filter in a reflective display is proportional to the luminous transmittance of each color in a transparency display, since it becomes equal, when considering as the composition which does not prepare a light filter in a reflective display, with a reflective display, it is desirable in changing the area of the field which is not performed in the color display of a reflective display according to the luminous transmittance of each color of the light filter used for a transparency

[0075] Namely, the liquid crystal display according to claim 16 concerning this invention In a liquid crystal display given in any 1 term of claims 1-15 in order to solve the above-mentioned technical problem To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple The field corresponding to a reflective display at least among the fields which the light filter which has transparency color is allotted, and constitute the above-mentioned viewing area in part It is characterized by allotting the light filter allotted to the field corresponding to the transparency display in the above-mentioned substrate, and the light filter which has the same lightness.

[0076] Moreover, the liquid crystal display according to claim 17 concerning this invention In a liquid crystal display given in any 1 term of claims 1-15 in order to solve the above-mentioned technical problem To the field corresponding to a transparency display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple The field corresponding to a reflective display at least among the fields which the light filter which has transparency color is allotted, and constitute the above-mentioned viewing area in part It is characterized by allotting the light filter which has transparency color with lightness higher than the light filter allotted to the field corresponding to the transparency display in the above-mentioned substrate.

[0077] Furthermore, the liquid crystal display according to claim 18 concerning this invention In a liquid crystal display given in any 1 term of claims 1-17 in order to solve the above-mentioned technical problem The inside of the field which constitutes the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple, It is characterized by setting at least the area of the field which the light filter which has transparency color is allotted, and does not perform the color display of a reflective display according to the luminous transmittance of the transparency color of the above-mentioned light filter as the field corresponding to a transparency display.

[0078] Moreover, it sets in the second use gestalt (use gestalt which indicates it a subject by reflective). By allotting the light filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple It excels in visibility, and high resolution color display is possible, and the liquid crystal display which can use both the reflected light and the transmitted light for a display can be offered.

[0079] And when performing color display in this way, especially the thing for which the light filter which allots the light filter which has transparency color at least to a reflective display, and performs a color display, has at least the same saturation as the light filter of a transparency display allotted to the reflective display in part in a transparency display, not using a light filter, or has the high transparency color of saturation rather than it is allotted is effective in each pixel.

[0080] In the use gestalt which indicates it a subject by reflective, in a transparency display, when monochrome display is performed not using a light filter, since the permeability of light rises, it is possible to set up a transparency display still smaller. Thereby, the area of a reflective display can be secured more greatly and a better display can usually be obtained in the reflective display at the time of use.

[0081] Moreover, in the use gestalt which indicates it a subject by reflective, the contribution to the lightness of monochrome display of the transparency display in each pixel can be set up proper in consideration of a luminous transmittance by changing the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of each color of the light filter used for a reflective display.

[0082] That is, the liquid crystal display according to claim 19 concerning this invention is characterized by allotting the light filter which has transparency color to the field corresponding to a reflective display at least among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple in the liquid crystal display given in any 1 term of claims 1-15, in order to solve the above-mentioned technical problem.

[0083] Moreover, the liquid crystal display according to claim 20 concerning this invention is characterized by setting

up the area of the field which does not perform the color display of a transparency display according to the luminous transmittance of the transparency color of the above-mentioned light filter in the liquid crystal display according to claim 19, in order to solve the above-mentioned technical problem.
[0084] Furthermore, the liquid crystal display according to claim 21 concerning this invention In a liquid crystal display given in any 1 term of claims 1-15 in order to solve the above-mentioned technical problem To the field corresponding to a reflective display among the fields which constitute the viewing area of each pixel in one substrate among the substrates of the above-mentioned couple The field corresponding to a transparency display at least among the fields which the light filter which has transparency color is allotted, and constitute the above-mentioned viewing area in part It is characterized by allotting the light filter allotted to the field corresponding to the reflective display in the above-mentioned substrate, and the light filter in which saturation has the transparency color more than equivalent.
[0085] Moreover, since the above-mentioned liquid crystal display concerning this invention is equipped with the reflective display as mentioned above, it doubles and has the feature of the low power in the conventional reflected type liquid crystal display. However, continuing maintaining this at a lighting state causes increase of power consumption using a big lighting light of power consumption.
[0086] Then, in order that the liquid crystal display according to claim 22 concerning this invention may solve the above-mentioned technical problem, it has the lighting system which carries out incidence of the light to any 1 term of claims 1-21 from the tooth back of this liquid crystal display element in the liquid crystal display of a publication at the above-mentioned liquid crystal display element, and is characterized by this lighting system serving as a screen brightness change means to change the brightness of the screen.
[0087] According to the above-mentioned composition, coexistence with a low power and visibility can be aimed at by changing the brightness of the screen by the lighting system.
[0088] Furthermore, in order that the liquid crystal display according to claim 23 concerning this invention may solve the above-mentioned technical problem, in the liquid crystal display according to claim 22, the above-mentioned lighting system is characterized by changing the brightness of the screen according to adaptation luminance, so that consciousness lightness may be set to 10 or more brils and less than 30 brils.
[0089] The above-mentioned consciousness lightness is prescribed by adaptation luminance and the brightness of the screen. At this time, it is very desirable to change the brightness of the screen so that the above-mentioned consciousness lightness may be acquired because the above-mentioned lighting system changes the intensity of lighting, putting out lights, or lighting according to the adaptation luminance which changes with the contents of a display of a liquid crystal display and visual environment, such as lighting, when aiming at coexistence with a low power and visibility. When the above-mentioned lighting system is especially controlled by press coordinate detection blocking force meanses, such as a touch panel, etc. from the liquid crystal display element outside, the above-mentioned effect will become much more remarkable.
[0090] Moreover, low-power-ization can be attained, while according to the above-mentioned composition being able to improve the visibility in the situation which the transparency display has mainly contributed to the display and being able to realize good visibility.
[0091] Moreover, in the transflective type liquid crystal display concerning this invention, as compared with the reflected type liquid crystal display using the so-called front light, use of press coordinate detection blocking force meanses, such as a touch panel, is easy, and there is a big advantage at this point. Therefore, it is effective to realize the display good at a transflective type using such a press coordinate detection blocking force means because of the small liquid crystal display of the power consumption of good input unit one apparatus.
[0092] That is, the liquid crystal display according to claim 24 concerning this invention is characterized by providing a press coordinate detection blocking force means to detect the coordinate position pressed when it was arranged in piles and pressed by any 1 term of claims 1-23 in the liquid crystal display of a publication at the screen, in order to solve the above-mentioned technical problem.
[0093] Furthermore, since it is compatible in curtailment of power consumption, and good visibility, it is effective to change the brightness of the lighting system which influences the power consumption of a liquid crystal display according to this signal, and to change the brightness of the screen, since it is easily detected that the observer is using display with the signal of this press coordinate detection blocking force means when such a press coordinate detection blocking force means is used, or to change liquid crystal orientation.
[0094] Then, the liquid crystal display according to claim 25 concerning this invention In order to solve the above-mentioned technical problem, it sets to a liquid crystal display according to claim 22 or 23. A press coordinate detection blocking force means to detect the coordinate position pressed when it was arranged in piles and pressed by the screen is provided, and the above-mentioned lighting system is characterized by for the output signal of the above-mentioned press coordinate detection blocking force means being interlocked with, and changing the brightness of the

screen.
[0095] Moreover, the liquid crystal display according to claim 26 concerning this invention In order to solve the above-mentioned technical problem, it sets to a liquid crystal display according to claim 1 or 2. A press coordinate detection blocking force means to detect the coordinate position pressed when it was arranged in piles and pressed by the screen is provided. the above-mentioned orientation mechanism It is characterized by for the output signal of the above-mentioned press coordinate detection blocking force means being interlocked with, and changing the orientation state of the liquid crystal layer at least in one side among the above-mentioned reflective display and a transparency display.

[0096] Moreover, when the above-mentioned liquid crystal display concerning this invention is equipped with both the above-mentioned press coordinate detection blocking force means and a polarizing plate, the above-mentioned press coordinate detection blocking force means and a polarizing plate are arranged in order of a polarizing plate, a press coordinate detection blocking force means, and a liquid crystal display element.
[0097] Namely, the liquid crystal display according to claim 27 concerning this invention In a liquid crystal display given in any 1 term of claims 1-26 in order to solve the above-mentioned technical problem The press coordinate detection blocking force means and polarizing plate which detect the coordinate position pressed when it was arranged in piles and pressed by the screen are provided, and it is characterized by arranging the above-mentioned polarizing plate, the press coordinate detection blocking force means, and the liquid crystal display element at this order.
[0098] By arranging the above-mentioned polarizing plate, a press coordinate detection blocking force means, and a liquid crystal display element in this way, absorption by the polarizing plate can also absorb the unnecessary reflected light by the press coordinate detection blocking force means, and can reduce this unnecessary reflected light. Therefore, according to the above-mentioned composition, the visibility of the liquid crystal display concerning this invention can be improved.
[0099]
[Embodiments of the Invention] The liquid crystal display by this invention is characterized by the ability of the liquid crystal orientation of a reflective display, and the liquid crystal orientation of a transparency display to take the state of differing at this time. Here, liquid crystal orientation shall show not only the average orientation direction of the liquid crystal molecule in a point with a liquid crystal layer but the coordinate dependency of the average orientation direction to the coordinate taken in the direction of a normal of the layer of a stratified liquid crystal layer. Then, this invention classifies and explains greatly the orientation mechanism in which it is used for the method and this method of realizing liquid crystal orientation which is different by the reflective display and the transparency display to three kinds.
[0100] The 1st method is a method of changing the liquid crystal orientation of a reflective display, and the liquid crystal orientation of a transparency display, by using the orientation mechanism produced so that conditions with a liquid crystal layer might differ by the transparency display and the reflective display.
[0101] Specifically as the 1st method of the above, it is (1). The method and (2) using the orientation mechanism which carries out twist orientation so that it may have the twist angle from which liquid crystal orientation completely differs by the transparency display and the reflective display The method using the orientation mechanism in which the tilt angle to the substrate of liquid crystal orientation is made to change greatly etc. is mentioned. Moreover, in the 1st method of the above, it is (3). The method of arranging liquid crystal material which is different by the transparency display and the reflective display, (4) How (by the transparency display and the reflective display in this case) to change a transparency display and a reflective display in the kind and concentration of the coloring matter mixed in liquid crystal material The liquid crystal display which it is included that the same liquid crystal material may be used etc. and applied to this invention possesses the mechanism made when realizing such a method as an orientation mechanism of this invention. Moreover, the orientation mechanisms in which it is used for the 1st method of the above and this method are these (1). - (4) A method may be combined and the orientation mechanism in which it is used for these methods and this method can realize liquid crystal orientation which is different by the reflective display and the transparency display.
[0102] The 2nd method is a method (namely, the method as the contents rewriting means of a display that the orientation mechanism in which liquid crystal orientation is changed by the transparency display and the reflective display is the same) of changing liquid crystal orientation by the transparency display and the reflective display by the contents rewriting means of a display which rewrites the contents of a display in connection with the passage of time. The existing rewriting means of a display can be used as a contents rewriting means of a display by which it is used when adopting this method.
[0103] Specifically as the 2nd method of the above, it is (5). The method of changing the method (i.e., the voltage itself used as a content rewriting means of a display) of rewriting liquid crystal orientation by the transparency display and

the reflective display by using an electrode which is different by the transparency display and the reflective display as an orientation mechanism etc. is employable. Moreover, it is (6) as the 2nd method of the above. Although the electrode is the same, you may use the method of changing the voltage substantially impressed to liquid crystal orientation. Above (6) When adopting a method, you may change the liquid crystal orientation of a transparency display and the liquid crystal orientation of a reflective display which are driven by the common electrode by arranging the insulator (for example, insulator layer) of thickness which is different by the reflective display and the transparency display between a liquid crystal layer and the electrode which drives it. Moreover, (7) You may use the method of changing the direction of electric field by the transparency display and the reflective display. For example, it is arranged in parallel with one side of the substrate which pinches a liquid crystal layer, and when displaying on a liquid crystal layer by the electrode group which gives respectively different potential by changing the direction of liquid crystal orientation within a liquid crystal stratification plane, since liquid crystal orientation differs greatly, you may use respectively for a reflective display and a transparency display the field where these liquid crystal orientation differs inter-electrode and on an electrode. Furthermore, you may adopt the method of giving respectively different potential to the liquid crystal layer which carried out orientation perpendicularly to the substrate by the same electrode group. For example, an electrode, insulators, or such combination are equivalent to the orientation mechanism of this invention, and the obtained liquid crystal display which was used when the 2nd method of the above was adopted and the above-mentioned method was realized has become a thing possessing these orientation mechanisms.

[0104] The 3rd method is a method of changing the thickness of the liquid-crystal layer which is the element which determines an optical property although the liquid crystal orientation itself is not greatly different by the reflective display and the transparency display, and the insulator layer formed in thickness which is different by for example, the reflective display and the transparency display, the substrate formed in the thickness or the configuration in which a reflective display differs from a transparency display are used for realization of this method as the above-mentioned orientation mechanism.

[0105] When adopting the 3rd method of the above, you may use for liquid crystal orientation the liquid crystal orientation twisted uniformly like TN method used with the liquid crystal display which uses two polarizing plates. In this case, orientation of the liquid crystal orientation is carried out in parallel to a substrate between the substrates which pinch a liquid crystal layer, and twist orientation of the direction of orientation is carried out, changing a direction within a substrate flat surface according to the distance from one substrate. If this liquid crystal orientation is changed and liquid crystal thickness is used for a reflective display and a transparency display for it, since an optical property changes with liquid crystal thickness, it can realize a good display by both the reflective display and the transparency display.

[0106] Moreover, also in GH method, since there is the same effect as the case where coloring matter concentration is substantially changed by change of liquid crystal thickness, even if the liquid crystal orientation itself is almost the same at a reflective display and a transparency display, it can realize a good display to each of a reflective display and a transparency display.

[0107] As mentioned above, although the orientation mechanism in which it is used for the method and this method of realizing liquid crystal orientation which is different by the reflective display and the transparency display is roughly classified into three kinds, the liquid crystal display method used in the liquid crystal display concerning this invention realized according to these methods and orientation mechanisms is not limited especially that what is necessary is just to choose orientation change of liquid crystal from the method group used for a display suitably. Specifically as the above-mentioned liquid crystal display method used in this invention, various modes, such as for example, TN method which is the mode in which the nematic phase of a liquid crystal constituent is used for a display, a STN method, pneumatic bistability mode, perpendicular orientation mode, hybrid orientation mode, and ECB (electrically controlled biriefringence; electric-field control birefringence) mode, can be used. Moreover, it can use as the above-mentioned liquid crystal display method with which for example, the polymer dispersed liquid crystal mode which is the mode in which dispersion is used, a dynamic scattering method, etc. are used in this invention. Furthermore, since the surface passivation strong dielectric liquid crystal display method using the ferroelectric liquid crystal constituent and the non-threshold switching antiferroelectric liquid crystal display method which used antiferroelectricity liquid crystal also use orientation change for a display, it can be used as the above-mentioned liquid crystal display method used in this invention.

[0108] Moreover, when adopting the 3rd method of the above, the above-mentioned liquid crystal display method used in this invention may be a method using the modulation of optical activity like TN method, may be a method using the modulation of a retardation like ECB mode, and may be a method with which the rate of the absorption of light (absorbance) is modulated like GH method. When adopting the 3rd method of the above, including these methods, liquid crystal thickness is a method used as the main determinants of an optical property, and setting up liquid crystal

thickness thickly by the transparency display, and setting up liquid crystal thickness thinly by the reflective display can adopt all the methods that have the effect of good display property realization.
[0109] The substrate of the couple by which the orientation means was given as mentioned above to the front face on which a liquid crystal display counters in this invention, It is the liquid crystal display equipped with the liquid crystal display element which has the liquid crystal layer pinched between the substrates of this couple. It is arbitrary and the orientation mechanism for making it simultaneously take at least two kinds of different orientation states is provided to a different field used for the display in the above-mentioned liquid crystal layer. A reflective means is allotted to at least one field among the fields which show a different orientation state in the above-mentioned liquid crystal layer. the account of a top And the reflective display to which the field which shows a different orientation state performs a reflective display, By being used for the transparency display which performs a transparency display, the permeability or reflection factor based on a size of the amount of modulations of the optical physical quantity according to the orientation state of a liquid crystal layer can be obtained, there is no parallax, and a high contrast ratio can be realized. Consequently, while it is possible to raise visibility when the circumference is dark, good visibility can be acquired even when an ambient light is strong.
[0110] Moreover, when the grade of the amount of modulations of each optical physical quantity, such as the amount of absorption of light and phase contrast by the optical anisotropy, is independently changed by the reflective display and the transparency display, Even when the direction of orientation of the liquid crystal by impression of voltage is almost the same in the whole field for using for the display of a liquid crystal layer, in the field in which the liquid crystal thickness of a liquid crystal layer differs Since it has substantially the same operation as the case where the direction of orientation of a liquid crystal layer is changed in this field, the liquid crystal display concerning this invention It is the liquid crystal display equipped with the liquid crystal display element which has the liquid crystal layer pinched between the substrate of the couple by which the orientation means was given to the front face which counters, and the substrate of this couple. While each field where the field used for the display in the above-mentioned liquid crystal layer consists of a field which has at least two kinds of different liquid crystal thickness, and the above-mentioned liquid crystal thickness differs is used for the reflective display and the transparency display At least, a reflective means is allotted to a reflective display and the liquid crystal thickness of the above-mentioned reflective display is good for it also as composition set up smaller than a transparency display.
[0111] Also in the above-mentioned composition, the permeability or reflection factor based on a size of the amount of modulations of the optical physical quantity in a field which is different in liquid crystal thickness can be obtained, and this becomes possible to set up an optical parameter independently by the transparency display and the reflective display. Therefore, according to the above-mentioned composition, there is no parallax, a high contrast ratio can be realized, and while it is possible to raise visibility when the circumference is dark, good visibility can be acquired even when an ambient light is strong.
[0112] Hereafter, the gestalt 1 of operation and the gestalt 2 of operation mainly explain especially the liquid crystal display that performs a good reflective display and a good transparency display by changing liquid crystal thickness by the reflective display and the transparency display.
[0113] [Gestalt 1 of operation] The gestalt of this operation mainly explains below the liquid crystal display which used GH method with reference to drawing 1 .
[0114] Drawing 1 is the important section cross section of the liquid crystal display concerning the gestalt 1 of this operation. This liquid crystal display is equipped with the back light 13 (lighting system) as a background lighting means if needed while it is equipped with a liquid crystal cell 100 (liquid crystal display element), as shown in drawing 1 . These liquid crystal cells 100 and the back light 13 are arranged in order of the liquid crystal cell 100 and the back light 13 from the observer (user) side.
[0115] The electrode substrate 101 (the 1st substrate) to which the liquid crystal layer 1 equipped with the orientation film 2 the side (interface on the 1st substrate which touches the liquid crystal layer 1) which touches this liquid crystal layer 1 as a liquid crystal cell 100 was shown in drawing 1 , It has the composition pinched by the electrode substrate 102 (the 2nd substrate) which equipped with the orientation film 3 the side (interface on the 2nd substrate which touches the liquid crystal layer 1) which touches the liquid crystal layer 1.
[0116] The electrode 6 (voltage impression means) for impressing voltage to the liquid crystal layer 1 is formed on the substrate 4 which turns into the above-mentioned electrode substrate 101 from the glass substrate which has a translucency, and the orientation film 2 (orientation mechanism) with which rubbing processing was performed is formed so that this electrode 6 may be covered.
[0117] On the other hand, the electrode 7 (voltage impression means) as a counterelectrode which counters an electrode 6 is formed through the insulator layer 11 at the above-mentioned electrode substrate 102 which countered the above-mentioned electrode substrate 101 and was prepared on both sides of the liquid crystal layer 1 on the

substrate 5 which has a translucency in the liquid crystal layer 1 that voltage should be impressed.

[0118] The above-mentioned insulator layer 11 is formed in the field corresponding to the field used for the display in the above-mentioned liquid crystal layer 1 so that it may have partially different thickness so that the field used for the display in the above-mentioned liquid crystal layer 1 may have at least two kinds (the form of this operation two kinds) of different liquid crystal thickness. In more detail, the above-mentioned insulator layer 11 is a field corresponding to the transparency display 10, and it is formed so that thickness may become thin rather than the field corresponding to the reflective display 9.

[0119] The wrap reflective film 8 (reflective means) is formed in the field corresponding to the reflective display 9 in the above-mentioned electrode substrate 102 in the above-mentioned electrode 7, and further, the orientation film 3 (orientation mechanism) with which rubbing processing was performed is formed in it so that these electrodes 7 and the reflective film 8 may be covered.

[0120] Here, an electrode 6-7 is a transparent electrode formed of ITO (indium stannic-acid ghost). Moreover, a display is controlled by the voltage which the voltage for making the liquid crystal layer 1 produce electric field was impressed to the electrode 6-7, and was based on the content of a display being impressed.

[0121] Moreover, the reflective film 8 has light reflex nature, for example, is produced by metals, such as aluminum and silver, the dielectric multilayer reflecting mirror, etc. When the reflective film 8 is produced by the conductor, this reflective film 8 may be holding an additional post of the function as an electrode instead of an electrode 7. That is, the reflective film 8 may be a reflective pixel electrode which serves both as the liquid crystal drive electrode which drives the liquid crystal layer 1, and a reflective means. Furthermore, the above-mentioned reflective film 8 may be a color reflective film which reflects the light of the wavelength-range region suitably chosen from the light.

[0122] In addition, the quality of the material, the formation method, etc. of each part material which constitute the above-mentioned electrode substrate 101-102 are not necessarily limited to the above-mentioned publication, and a well-known material and the method in ordinary use can be conventionally used for them. Moreover, the composition of the above-mentioned liquid crystal display is not limited to the above-mentioned composition, either, and you may have directly the composition with which voltage is impressed to the electrode 6-7 corresponding to the reflective display 9 and the transparency display 10 from the exterior of a liquid crystal cell 100 with the signal from the touch panel (press coordinate detection blocking force means) explained with the gestalt of operation mentioned later. Moreover, you may have the composition in which active elements, such as a TFT element and MIM, are prepared as a switching element.

[0123] As the above-mentioned electrode substrate 101-102 is shown in drawing 1 , opposite arrangement is carried out so that the orientation film 2-3 may counter, and the liquid crystal layer 1 is formed by being stuck using an enclosure sealing compound etc. and introducing a liquid crystal constituent into the opening.

[0124] Moreover, a back light 13 is seen from an observer (user), and is arranged at the tooth-back, i.e., electrode substrate 102 rear face, side of the above-mentioned liquid crystal cell 100. This back light 13 is mainly constituted by light source 13a and transparent material 13b. Light source 13a is arranged in accordance with the side of for example, transparent material 13b, and, thereby, transparent material 13b carries out outgoing radiation of the light which made the side by the side of light source 13a arrangement plane of incidence, and carried out incidence from light source 13a to the liquid crystal cell 100 which is an illuminated object. In addition, the existing lighting system can be used as the above-mentioned back light 13.

[0125] In the liquid crystal display which has the above-mentioned composition, it displays on the screen from a substrate 4, i.e., observer, side by the reflective display 9 in which the reflective film 8 was formed by controlling by change of liquid crystal orientation the reflectivity of the ambient light which carries out incidence. Moreover, in the transparency display 10 in which the reflective film 8 is not formed, it displays on the screen from a substrate 5 side by controlling by change of liquid crystal orientation the transmitted light intensity of the light which carries out incidence. In this case, you may use the lighting light by the back light 13 installed in liquid crystal cell 100 tooth back if needed.

[0126] The above-mentioned liquid crystal display shown in drawing 1 is produced by liquid crystal thickness which is different by the reflective display 9 and the transparency display 10 as mentioned above. Thereby, the above-mentioned liquid crystal display has liquid crystal orientation which is substantially different by the reflective display 9 and the transparency display 10.

[0127] Here, the composition of the liquid crystal display for obtaining liquid crystal thickness which is different by the reflective display 9 and the transparency display 10 is explained below.

[0128] What is necessary is just to form so that it may have thickness which is different by the reflective display 9 and the transparency display 10 in an insulator layer 11 as shown in drawing 1 in order to obtain liquid crystal thickness which is different by the reflective display 9 and the transparency display 10.

[0129] in addition, the substrate (namely, the above-mentioned electrode substrate 101-102) to which the composition for changing liquid crystal thickness by the reflective display 9 and the transparency display 10 is pinching liquid crystal -- at least -- either -- even having -- what is necessary is just to be

[0130] Therefore, the above-mentioned insulator layer 11 may be allotted not on the substrate 5 but on the substrate 4. However, even if it is such a case, the reflective film 8 is formed on the substrate 5 by the side of the electrode substrate 102 (namely, pinching the liquid crystal layer 1 with a screen side (electrode substrate 101 side) opposite side).

[0131] In addition, although considered as the composition to which liquid crystal thickness is changed by the reflective display 9 and the transparency display 10 by changing the thickness of an insulator layer 11 in the liquid crystal display shown in drawing 1 in the field corresponding to the reflective display 9 in an insulator layer 11, and the field corresponding to the transparency display 10 It is good also as composition to which liquid crystal thickness is changed by the reflective display 9 and the transparency display 10 by forming a substrate 4 or substrate 5 itself in the same configuration as the insulator layer 11 shown in drawing 1 .

[0132] In moreover, the field corresponding to the reflective display 9 in an insulator layer 11 and the field corresponding to the transparency display 10 When changing the thickness, as shown in drawing 1 , the insulator layer 11 of the field corresponding to the transparency display 10 It is good also as composition by which may be formed so that it may become thinner than the thickness of the insulator layer 11 of the field corresponding to the reflective display 9, or the insulator layer 11 is formed in the field corresponding to the reflective display 9, and the insulator layer 11 is not formed in the field corresponding to the transparency display 10.

[0133] Furthermore, in order to maintain the liquid crystal thickness of the liquid crystal layer 1 in the reflective display 9 and the transparency display 10 at a predetermined value, a spacer (not shown) may be arranged on the liquid crystal layer 1, and liquid crystal thickness may be maintained at the predetermined value by other technique. For example, when arranging a spherical spacer on the liquid crystal layer 1, the liquid crystal thickness in the reflective display 9 with thin liquid crystal thickness turns into thickness almost equal to the diameter of this spacer.

[0134] As mentioned above, the substrate pair 1 prepared as mentioned above, i.e., the liquid crystal layer pinched by the above-mentioned electrode substrate 101-102, consists of a liquid crystal constituent. While use the liquid crystal constituent which made dichroism coloring matter 12 mix in liquid crystal, making the liquid crystal layer 1 produce electric field and controlling [as a liquid crystal display method by this liquid crystal layer 1,] liquid crystal orientation to be shown in drawing 1 , for example, the direction of orientation of dichroism coloring matter 12 can be changed simultaneously, and GH method which displays using change of the absorption coefficient by dichroism can be used.

[0135] Next, a display principle in case operation of the liquid crystal layer 1 by GH method and the liquid crystal thickness in the reflective display 9 differ from the liquid crystal thickness in the transparency display 10 is explained below with reference to drawing 1 .

[0136] When displaying using the liquid crystal display shown in drawing 1 , as an arrow shows, it displays at the transparency display 10 by passing the liquid crystal layer 1 only at once, carrying out outgoing radiation of the light from back light 13 grade and liquid crystal layer 1 back from the screen, and making it into display light. As for the dichroism coloring matter 12 mixed into the liquid crystal constituent arranged on the liquid crystal layer 1, the rate of the absorption of light changes with liquid crystal orientation at this time. for this reason, as shown in transparency display 10a, while liquid crystal is carrying out orientation (parallel orientation is called hereafter) of the transparency display 10 in parallel to the screen (electrode substrate 101) As it becomes a dark display since the dichroism coloring matter 12 in this portion absorbs strongly the light which passes the liquid crystal layer 1, and shown in transparency display 10b Since the absorption of light by dichroism coloring matter 12 is weak while liquid crystal is carrying out orientation (perpendicular orientation is called hereafter) perpendicularly to the screen (electrode substrate 101), it becomes the Ming display and a display becomes possible.

[0137] On the other hand, in the reflective display 9, the light which carried out incidence to the screen from the observer side is used for a display. That is, as an arrow shows, after the light which carried out incidence to the screen passes the liquid crystal layer 1, it is reflected by the reflective film 8, and it passes the liquid crystal layer 1 again, it carries out outgoing radiation from the screen, and it turns into display light. Since the absorption of light by dichroism coloring matter 12 is weak while liquid crystal is carrying out perpendicular orientation as it becomes a dark display and is shown in reflective display 9b since the dichroism coloring matter 12 in this portion absorbs light strongly while liquid crystal is carrying out parallel orientation, as the reflective display 9 is shown in reflective display 9a at this time, it becomes the Ming display and a display becomes possible.

[0138] Therefore, the Ming display and a dark display are attained by giving the potential difference between an electrode 6 and an electrode 7, and controlling liquid crystal orientation. In addition, when especially the initial

orientation state of liquid crystal is not limited and voltage is not impressed [for example,] in this case, parallel orientation may be carried out, it may be twisting further, and conversely, when not impressing voltage, perpendicular orientation may be carried out. In the case of the former, a dielectric constant anisotropy can use positive liquid crystal for liquid crystal (namely, when the liquid crystal orientation when not impressing voltage is parallel orientation or it is twisting further). On the other hand, in the case of the latter, as liquid crystal, a dielectric constant anisotropy can use negative liquid crystal (namely, when the liquid crystal orientation when not impressing voltage is perpendicular orientation). Thus, although especially the initial orientation state of liquid crystal is not limited, it needs to adjust the thickness of an insulator layer 11 so that the liquid crystal thickness suitable for the gestalt of the liquid crystal orientation to be used may be obtained.
[0139] Moreover, as shown in drawing 1 , in order to produce the liquid crystal layer 1 easily, it is desirable to have the structure which the liquid crystal layer 1 opened for free passage over the reflective display 9 and the transparency display 10, or two or more display pixels like the usual liquid crystal display.
[0140] Thus, even if it is the case where the liquid crystal layer 1 is open for free passage between the reflective display 9 and the transparency display 10 Distance when liquid crystal thickness differs by the transparency display 10 and the reflective display 9, while display light and the becoming light finally pass the liquid crystal layer 1 It becomes possible to set up almost similarly in the distance in which this light passes the liquid crystal layer 1 only at once in the transparency display 10, and the distance in which this light goes and comes back to the liquid crystal layer 1 in the reflective display 9.
[0141] For this reason, while the reflective lightness of the reflective display 9 and the transparency lightness of the transparency display 10 can set up almost to the same extent, the contrast ratio in the reflective display 9 and the contrast ratio in the transparency display 10 can be set up almost to the same extent. If it puts in another way, in GH method using the absorption of light by dichroism coloring matter 12, changing liquid crystal thickness by the reflective display 9 and the transparency display 10 Since there is the same effect as the case where coloring matter concentration is changed, substantially, by changing liquid crystal thickness by the transparency display 10 and the reflective display 9 Mixing concentration of the dichroism coloring matter 12 suitable for the reflective display 9 to a liquid crystal constituent and mixing concentration of the dichroism coloring matter 12 suitable for the transparency display 10 can be made almost equal. Therefore, the reflective display 9 and the transparency display 10 can realize a good display simultaneously by the liquid crystal layer 1 which the reflective display 9 and the transparency display 10 are opening for free passage. That is, by the reflective display 9 and the transparency display 10, a display contrast ratio is of the same grade, and the lightness of the Ming display also becomes of the same grade.
[0142] In addition, the lightness in this case shall show the rate observed by the observer as a display light in the reflective display 9 or the transparency display 10 among the light which carries out incidence to the liquid crystal layer 1, and a contrast ratio shall ** and define the lightness of the Ming display by lightness of a dark display.
[0143] Moreover, when the contrast ratio suitable for the reflective display is generally compared with the contrast ratio suitable for the transparency display, it is required that the contrast ratio suitable for the transparency display should be higher than the contrast ratio suitable for the reflective display. Therefore, in order to fill this demand, it is more effective rather than setting up equally the contrast ratio in the reflective display 9, and the contrast ratio in the transparency display 10 the liquid crystal thickness in the transparency display 10 is set up more thickly than the liquid crystal thickness in the reflective display 9, and the contrast ratio in the transparency display 10 exceeds the contrast ratio in the reflective display 9, when performing a good display.
[0144] Although a concrete example and the example of comparison are hereafter given and explained with reference to drawing 1 - drawing 3 about the liquid crystal display concerning the form of this operation based on the display principle mentioned above, the liquid crystal display concerning the form of this operation is not limited at all by the following examples.
[0145] [Example 1] By this example, by liquid crystal's carrying out orientation to a perpendicular mostly to a screen normal, while not impressing voltage to the liquid crystal layer 1, and impressing voltage to the liquid crystal layer 1, liquid crystal inclines to the screen and the liquid crystal display with which the dielectric constant anisotropy which carries out orientation uses the liquid crystal layer 1 of GH method using negative liquid crystal for a display is explained. First, the manufacture method of this liquid crystal display is explained below.
[0146] first, it was alike on the transparent substrate 4, and 140nm of ITO(s) was formed by sputtering, and the electrode 6 (transparent electrode) of a predetermined pattern was produced by carrying out etching processing using photo lithography In addition, the glass substrate was used as the above-mentioned substrate 4.
[0147] Next, the orientation film 2 was formed on the electrode 6 forming face in this substrate 4 by arranging a perpendicular orientation film by offset printing, and calcinating this in 200-degree C oven further. Then, orientation processing was performed to the orientation film 2 by rubbing, and the electrode substrate 101 as an observer side

substrate was produced.
[0148] Here, a perpendicular orientation film has the property to which the normal direction of a film surface is made to carry out orientation of the liquid crystal, and has further the property to which abundance grade inclination orientation of the liquid crystal orientation is carried out [the] from a normal by orientation processing of rubbing etc. The liquid crystal orientation after voltage impression inclines still more greatly toward the above-mentioned orientation processing direction for this inclination.
[0149] On the other hand, the sensitization resin which has insulation was applied with the spin coat on the substrate 5, a sensitization resin did not remain in the transparency display 10 by mask irradiation of ultraviolet radiation further, but in the reflective display 9, pattern formation of the insulator layer 11 was carried out so that it might be formed at the thickness this sensitization resin of whose is 3 micrometers. At this time, the electrode 7 formed at a back process formed the pattern edge portion of an insulator layer 11 in the level difference configuration gently-sloping enough so that plasmotomy might not be carried out by the level difference of this insulator layer 11. In addition, the substrate 4 and the same transparent glass substrate were used for the above-mentioned substrate 5.
[0150] Furthermore, 140nm of ITO(s) was formed by sputtering on the insulator layer 11 forming face in this substrate 5, and 200nm of aluminum which functions as an electrode of light reflex nature was further formed by sputtering on it. Subsequently, patterning of the obtained aluminum film was carried out by photo lithography and dry etching so that this aluminum film might remain only in the reflective display 9 (namely, portion which made the sensitization resin remain in case patterning of the sensitization resin was carried out that an insulator layer 11 should be formed), and the reflective film 8 was formed. And the electrode 7 (transparent electrode) of a predetermined pattern was further produced by carrying out etching processing of the lower layer ITO film of this reflective film 8 using photo lithography.
[0151] Next, the orientation film 3 was formed by the same method as the orientation film 2 of the above-mentioned electrode substrate 101 which is an observer side substrate on the above-mentioned electrode 7 in this substrate 5, and the reflective film 8 forming face. Then, orientation processing was performed to the above-mentioned orientation film 3 by rubbing, and the electrode substrate 102 was produced.
[0152] Among the electrode substrates 101-102 produced as mentioned above, around one electrode substrate, the seal resin (not shown) as an enclosure sealing compound was arranged, on the orientation film forming face in the electrode substrate of another side, as a spherical plastic spacer with a diameter of 4.5 micrometers was sprinkled and it was shown in drawing 1 , the electrode side was made to counter, the seal resin was hardened under pressurization, and the liquid crystal cell for liquid crystal pouring was produced. When the thickness (namely, thickness of the liquid crystal layer 1) of the opening for liquid crystal pouring in the reflective display 9 and the transparency display 10 of a liquid crystal cell for this liquid crystal pouring was measured by measurement of a reflected light spectrum, in the reflective display 9, it was 7.5 micrometers at 4.5 micrometers and the transparency display 10.
[0153] Furthermore, in case the dielectric constant anisotropy introduced into the liquid crystal cell for the above-mentioned liquid crystal pouring the liquid crystal constituent which comes to mix dichroism coloring matter 12 in negative liquid crystal, the concentration of dichroism coloring matter 12 was adjusted to concentration from which sufficient contrast ratio is obtained by the reflective display 9 and the transparency display 10. Furthermore, the chiral additive which gives a twist to the orientation of liquid crystal was added to the above-mentioned liquid crystal constituent, and with the orientation processing performed to the orientation film 2-3, by the reflective display 9 and the transparency display 10 in a voltage impression state which are used for a dark display, the twist of the liquid crystal orientation between the electrode substrates 101.102 of the upper and lower sides of the liquid crystal layer 1 set it as it so that it might become the same. Furthermore, the liquid crystal constituent was introduced into the liquid crystal cell for the above-mentioned liquid crystal pouring by the vacuum pouring-in method, and the liquid crystal display was produced.
[0154] When voltage was impressed to the liquid crystal layer 1, measuring the reflection factor of the reflective display 9 in the obtained liquid crystal display, and the permeability of the transparency display 10 under a microscope, the display property shown in drawing 2 was acquired. The voltage impressed to the liquid crystal layer 1 is a square wave currently inverted every 17msec, in drawing 2 , a horizontal axis shows the actual value of applied voltage, and a vertical axis shows lightness (a reflection factor or permeability). Moreover, in this drawing, a curve 111 shows the voltage dependency of the reflection factor of the reflective display 9, and a curve 112 shows the voltage dependency of the permeability of the transparency display 10.
[0155] As shown in a curve 111 and a curve 112, in the above-mentioned liquid crystal display, the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is both falling with impression of voltage. Moreover, when applied voltage was 1.8V, the reflection factor of the reflective display 9 was 55%, the permeability of the transparency display 10 was 52%, and when applied voltage was 5V, the permeability of

the transparency display 10 of the reflection factor of the reflective display 9 was 10% 11%.
[0156] That is, while the high value to which the lightness of the Ming display both exceeds 50% also to the transparency display 10 is shown also to the reflective display 9 according to the above-mentioned liquid crystal display, a contrast ratio is about 5, and the display excellent in visibility was able to be realized.
[0157] [Example 1 of comparison] Here, the example of comparison of the above-mentioned example 1 is shown. In this example 1 of comparison, the liquid crystal display for comparison was produced according to the manufacture method of the liquid crystal display shown in an example 1 in the liquid crystal display using GH method shown in an example 1 except having designed so that the liquid crystal thickness in the reflective display 9 and the liquid crystal thickness in the transparency display 10 might become the same.
[0158] More specifically, in this example of comparison, the insulator layer 11 which was produced on the substrate 5 of an example 1 was not produced, but both the liquid crystal thickness in the reflective display 9 and the liquid crystal thickness in the transparency display 10 produced the liquid crystal display which is 4.5 micrometers. That is, the electrode substrate of the upper and lower sides which counter on both sides of the liquid crystal layer 1 produced the liquid crystal display by both producing the smooth liquid crystal cell for liquid crystal pouring by the reflective display 9 and the transparency display 10, and introducing the liquid crystal constituent which mixed the same dichroism coloring matter 12 and same chiral additive as an example 1 in the liquid crystal cell for this liquid crystal pouring.
[0159] The display property which measured the reflection factor of the reflective display 9 and the permeability of the transparency display 10 in the obtained liquid crystal display by the same method as an example 1, and was acquired is shown in drawing 3 .
[0160] [Example 2 of comparison] In this example 2 of comparison, the liquid crystal display set up so that the liquid crystal constituent which made concentration of dichroism coloring matter 12 high might be introduced and the lightness and the contrast ratio of the transparency display 10 might become the optimal from the example 1 of comparison at the same liquid crystal cell as the example 1 of comparison was produced.
[0161] The display property which measured the reflection factor of the reflective display 9 and the permeability of the transparency display 10 in the obtained liquid crystal display by the same method as an example 1, and was acquired is combined with the result of the example 1 of comparison, and is shown in drawing 3 .
[0162] In drawing 3 , a horizontal axis shows the actual value of applied voltage, and a vertical axis shows lightness (a reflection factor or permeability). Moreover, in this drawing, a curve 121 shows the voltage dependency of the reflection factor of the reflective display 9 of the example 1 of comparison, and a curve 122 shows the voltage dependency of the permeability of the transparency display 10 of the example 1 of comparison. Moreover, a curve 123 shows the voltage dependency of the reflection factor of the reflective display 9 of the example 2 of comparison, and a curve 124 shows the voltage dependency of the permeability of the transparency display 10 of the example 2 of comparison.
[0163] As shown in a curve 121 and a curve 122, although the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is falling with impression of voltage, with the liquid crystal display obtained in the example 1 of comparison, both The permeability of the transparency display 10 was 66% to the reflection factor of the reflective display 9 in case applied voltage is 1.8V having been 51%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 22% 11%.
[0164] That is, in the reflective display 9, although the high lightness exceeding 50% and about five contrast ratio were obtained, since the liquid crystal thickness in this transparency display 10 was the same as the liquid crystal thickness in the reflective display 9 in the transparency display 10, although the lightness of the liquid crystal layer 1 was high, its contrast ratio was as low as about three, and display grace was low [lightness] according to the liquid crystal display obtained in the above-mentioned example 1 of comparison.
[0165] Moreover, both, as shown in a curve 123 and a curve 124, although the lightness (a reflection factor or permeability) in the reflective display 9 and the transparency display 10 is falling with the fall of voltage, with the liquid crystal display obtained in the example 2 of comparison The permeability of the transparency display 10 was 51% to the reflection factor of the reflective display 9 in case applied voltage is 1.8V having been 29%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 10% 3%.
[0166] That is, according to the liquid crystal display obtained in the above-mentioned example 2 of comparison, although the high lightness exceeding 50% and about five contrast ratio were obtained, since the liquid crystal thickness in this reflective display 9 was the same as the liquid crystal thickness in the transparency display 10 in the reflective display 9, although the contrast ratio was as high as about ten, lightness did not fill it with the transparency

display 10 to 30%, but it became a dark display by it.

[0167] or [that it is equivalent to the contrast ratio of the reflective display 9 in the contrast ratio of the transparency display 10 in the liquid crystal display of GH method so that clearly from comparison with the above-mentioned example 1 and the example 1-2 of comparison] -- or in order to have made it higher, it turns out that it is effective to set up more greatly than the thickness of the liquid crystal layer 1 of the reflective display 9 the thickness of the liquid crystal layer 1 of the transparency display 10

[0168] [Gestalt 2 of operation] As a liquid crystal display method concerning this invention, although the gestalt 1 of the aforementioned implementation explained the liquid crystal display which used GH method, as shown in drawing 4 , a substrate 4 and 5 may be pinched by the polarizing plate 14 and 15, and the method which uses the retardation and rotatory polarization (it is hereafter written as a polarization conversion operation collectively) of the liquid crystal layer 1 for a display may be adopted besides the above-mentioned GH method.

[0169] Then, the form of this operation mainly explains below the liquid crystal display which used the above-mentioned polarization conversion operation for the display with reference to drawing 4 . In addition, the same number is given to the component which has the function as the form 1 of the aforementioned implementation of explanation same for convenience, and the explanation is omitted.

[0170] Drawing 4 is the important section cross section of the liquid crystal display concerning the form of this operation. The liquid crystal display shown in drawing 4 is equipped with the aforementioned back light 13 (lighting system) if needed while it is equipped with a liquid crystal cell 200 (liquid crystal display element). These liquid crystal cells 200 and the back light 13 are arranged in order of the liquid crystal cell 200 and the back light 13 from the observer (user) side.

[0171] The electrode substrate 201 (the 1st substrate) to which the liquid crystal layer 1 equipped with the orientation film 2 the side (interface on the 1st substrate which touches the liquid crystal layer 1) which touches this liquid crystal layer 1 as a liquid crystal cell 200 was shown in drawing 4 , It is pinched by the electrode substrate 202 (the 2nd substrate) which equipped with the orientation film 3 the side (interface on the 2nd substrate which touches the liquid crystal layer 1) which touches the liquid crystal layer 1. Furthermore, while equipping the outside (namely, the opposed face with the electrode substrate 202 opposite side) of the electrode substrate 201 with the phase contrast compensating plate 16 and a polarizing plate 14 It has the composition which equipped the outside (namely, the opposed face with the electrode substrate 201 opposite side) of the electrode substrate 202 with the phase contrast compensating plate 17 and the polarizing plate 15. In addition, the above-mentioned phase contrast compensating plate 16-17 is used if needed, being prepared.

[0172] Various phase contrast compensating plates, such as an extension high polymer film, a liquid crystal orientation fixed high polymer film, and a mesomorphism high polymer film, can be used for the above-mentioned phase contrast compensating plate 16-17 used if needed in this invention. The optical operation is used for prevention of the coloring often seen, the change of the dependency of lightness to the potential difference of an electrode 6-7, and a pan for change of a display angle of visibility etc., when it does not have the phase contrast compensating plate 16-17 used.

[0173] Moreover, the electrode 6 for impressing voltage to the liquid crystal layer 1 is formed on the substrate 4 which turns into the above-mentioned electrode substrate 201 from the glass substrate which has a translucency, and the orientation film 2 with which rubbing processing was performed is formed so that this electrode 6 may be covered.

[0174] On the other hand, the electrode 7 as a counterelectrode which counters an electrode 6 is formed through the insulator layer 11 at the above-mentioned electrode substrate 202 which countered the above-mentioned electrode substrate 201 and was prepared on both sides of the liquid crystal layer 1 on the substrate 5 which has a translucency in the liquid crystal layer 1 that voltage should be impressed. However, in the liquid crystal display shown in drawing 4 , it has composition to which the electrode 7 in the reflective display 9 and the electrode 7 in the transparency display 10 are insulated electrically, and voltage is separately impressed from the liquid crystal cell outside. And the reflective film 8 is formed in the field corresponding to the reflective display 9 in the above-mentioned electrode substrate 202, and further, the orientation film 3 with which rubbing processing was performed is formed in it so that these electrodes 7 and the reflective film 8 may be covered. Moreover, the above-mentioned insulator layer 11 is formed so that the thickness of the field corresponding to the transparency display 10 in this insulator layer 11 may become thinner than the thickness of the field corresponding to the reflective display 9.

[0175] As the above-mentioned electrode substrate 201-202 is shown in drawing 4 , opposite arrangement is carried out so that the orientation film 2 and the orientation film 3 may counter, and the liquid crystal layer 1 is formed by being stuck using an enclosure sealing compound etc. and introducing a liquid crystal constituent into the opening.

[0176] In the above-mentioned liquid crystal display, the liquid crystal layer 1 which consists of a liquid crystal constituent mentioned above has the structure which was open for free passage between the reflective display 9 and the transparency display 10 in the Ming display. In drawing 4 , as shown in reflective display 9b and transparency display

10b, while carrying out parallel orientation of the liquid crystal of this liquid crystal layer 1, a polarization conversion operation arises to the light which passes the liquid crystal layer 1, and it serves as a dark display. On the other hand, as shown in reflective display 9a and transparency display 10a, while the liquid crystal of the liquid crystal layer 1 is carrying out perpendicular orientation, a polarization conversion operation is weak and serves as the Ming display.

[0177] Therefore, the Ming display and a dark display are attained by using the orientation change in reflective display 9aand9b, and transparency display 10a and 10b for a display as display luminous-intensity change in the linearly polarized light selection transparency operation by the polarizing plate 14 by the side of the screen which pinches the liquid crystal layer 1 and is arranged, and the polarizing plate 15 by the side of a back light 13. In addition, as mentioned above, in order to compensate the wavelength dependency of the refractive-index difference of the liquid crystal layer 1 in this case, in order to change the voltage dependency of the lightness modulated in the liquid crystal layer 1 if needed, or in order to change the angle of visibility of a display, the phase contrast compensating plate 16-17 as shown in drawing 4 may be used.

[0178] Thus, when using an optical anisotropy for a display, especially the initial orientation state of liquid crystal may not be limited, may be in the state in which the liquid crystal layer 1 in voltage the state where it does not impress carried out orientation in parallel to the screen, and may be in the state which carried out orientation perpendicularly. In the case of the former, a dielectric constant anisotropy can use positive liquid crystal for liquid crystal (namely, when the liquid crystal orientation in voltage the state where it does not impress is parallel orientation). On the other hand, in the case of the latter, as liquid crystal, a dielectric constant anisotropy can use negative liquid crystal (namely, when the liquid crystal orientation in voltage the state where it does not impress is perpendicular orientation).

[0179] Thus, when using an optical anisotropy for a display, it is effective [a state], although especially the initial orientation state of liquid crystal is not limited to adjust the thickness of an insulator layer 11 so that the liquid crystal thickness suitable for the gestalt of the liquid crystal orientation to be used may be obtained.

[0180] In order to realize a dark display by the above-mentioned reflective display 9, the light made into the linearly polarized light with the polarizing plate 14 is prepared first. And if needed, by the phase contrast compensating plate 16, a polarization state is changed, and rather than the transparency display 10, thickness is the liquid crystal layer 1 of the reflective display 9 set up thinly, and changes a polarization state further. this time -- conditions required for an ideal dark display -- as a result -- the polarization state on the reflective film 8 -- right and left -- it is considering as the circular polarization of light which may be the surroundings of which Moreover, conditions required in order to realize the ideal Ming display by the same reflective display 9 are making the polarization state on the reflective film 8 into the linearly polarized light. And the change of a display will be attained if liquid crystal orientation is electrically controllable between the Ming displays with this dark display.

[0181] That is, the phase contrast which the liquid crystal layer 1 will give to light by the time the light which carried out incidence to the liquid crystal layer 1 reaches the reflective film 8, when realizing a dark display (phase contrast of the display light on the reflective film 8), Between the phase contrast (phase contrast of the display light on the reflective film 8) which the liquid crystal layer 1 will give to light by the time the light which carried out incidence to the liquid crystal layer 1 reaches the reflective film 8, when realizing the Ming display the liquid crystal orientation which there is 1/4 wave (in general 90 degrees) of difference substantially, and realizes it -- for example, between the circular polarization of light [in / the control possibility of, i.e., a dark display, / electrically], and the linearly polarized lights in the Ming display -- control -- possible -- ****ing . At this time, the polarization direction of the linearly polarized light on the reflective film 8 which realizes the Ming display is good in the arbitrary directions.

[0182] Moreover, a display is performed by making it change in the liquid crystal layer 1 to which the light made into the linearly polarized light with the polarizing plate 15 in the transparency display 10 changed the polarization state by the phase contrast compensating plate 17 if needed, and thickness was subsequently thickly set rather than the reflective display 9, making it change with phase contrast compensating plates 16 further if needed, and carrying out outgoing radiation from a polarizing plate 14.

[0183] In this case, it is change of a polarization state just before carrying out incidence to a polarizing plate 14 which is used for a display. Therefore, what is necessary is just to adjust a polarization state just before carrying out incidence to a polarizing plate 14 that what is necessary is just to adjust a polarization state just before carrying out incidence to a polarizing plate 14 so that it may become the linearly polarized light which has the oscillating direction of the transparency shaft direction of a polarizing plate 14 in performing the Ming display, so that it may become the linearly polarized light which has the plane of vibration of the absorption shaft direction of a polarizing plate 14 in performing a dark display.

[0184] That is, the phase contrast given to the light which passes the liquid crystal layer 1 of the transparency display 10 when performing the Ming display (phase contrast of the display light which carries out outgoing radiation of the liquid crystal layer 1), A difference with the phase contrast (phase contrast of the display light which carries out

outgoing radiation of the liquid crystal layer 1) given to the light which passes the liquid crystal layer 1 of the transparency display 10 when performing a dark display It is possible to change a display if change of the orientation of the liquid crystal layer 1 is electrically controlled by impression of voltage to become 1/2 wave (in general 180 degrees) substantially.

[0185] 1/2 wave of phase control is the polarization conversion operation including the rotatory-polarization phenomenon in_which of it is equivalent to controlling the polarization direction of the linearly polarized light which carries out incidence to a polarizing plate 14, the refractive-index main shaft of not only control of the phase contrast by the retardation in which the refractive-index main shaft carried out orientation in parallel uniformly but the liquid-crystal layer 1 is twisted in connection with a twist of liquid crystal orientation, and the polarization direction of the linearly polarized light changes with change by the voltage of a twist of the orientation from the liquid-crystal layer 1 side etc. here. When the polarization conversion operation of the liquid crystal layer 1 which realizes this also takes into consideration application of the phase contrast compensating plate 16 or the phase contrast compensating plate 17, it is a polarization conversion operation between the general polarization states which intersected perpendicularly.

[0186] The liquid crystal orientation which enables the polarization conversion operation which realizes control (phase control of light) of the above polarization states You may be parallel (parallel to the screen), and uniform parallel orientation (homogeneous orientation) at a substrate 4-5. the orientation (twist orientation) twisted to the substrate 4-5 between parallel (parallel to the screen), and the substrate 4-5 (between the vertical substrates which countered on both sides of the liquid crystal layer 1) -- you may be -- moreover, the substrate 4-5 -- a perpendicular (perpendicular to the screen) -- you may be perpendicular orientation (homeotropic orientation) Furthermore, the hybrid orientation whose another side one interface of the liquid crystal layer 1 is parallel orientation, and is perpendicular orientation can be used.

[0187] In this case, it is desirable for it to be set as 60 degrees or more and 100 degrees or less between the above-mentioned substrates 4-5, or to specifically, be set as 0 times or more and 40 degrees or less as the above-mentioned twist orientation. Even if this reason does not change a rubbing direction by the transparency display 10 and the reflective display 9, it is because it becomes possible to reconcile the conditions suitable for the conditions suitable for the reflective display 9, and the transparency display 10.

[0188] When mass-producing a liquid crystal display, it is the design which changes as an optical design of the most desirable liquid crystal layer 1 between the upper limits of the range of driver voltage and minimums which are impressed to the liquid crystal layer 1 so that display lightness (a reflection factor or permeability) may monotonous-increase or monotonous decrease.

[0189] When taking the conditions of the above drive into consideration, the optical design of the simplest liquid crystal layer 1 is a design by which the electro-optics property that a display is controlled between the liquid crystal which carried out orientation to the screen perpendicularly substantially, and the liquid crystal which carried out orientation to the screen in parallel substantially so that display lightness increases [monotonous-] or decreases [monotonous-] is attained.

[0190] In this case, when an parallel orientation film is used and liquid crystal orientation parallel to the screen as non-impressed voltage liquid crystal orientation is realized especially, the conditions suitable for the reflective display and the conditions suitable for the transparency display exist clearly. Then, it is the so-called Jones about this condition. It asked by calculation by the matrix method, and the range with a suitable twist angle was searched for.

[0191] Consequently, in order to obtain a good display by reflective display, it became clear that the twist angle needs to be set as 0 times or more and 100 degrees or less.

[0192] that is, an invention-in-this-application person etc. first in the liquid crystal layer 1 which realizes a good display in a reflective display In order to find out that the operation which changes the circular polarization of light into the linearly polarized light efficiently is required in the liquid crystal orientation (it is substantially equal to the liquid crystal orientation in [voltage] not impressing when an parallel orientation film is used) which has a polarization conversion operation and to evaluate this It asked for the reflection factor at the time of carrying out incidence of the circular polarization of light to the liquid crystal layer 1 by the above-mentioned calculus. In addition, calculation asked for the reflection factor of the light to which incidence was carried out to the order of the phase contrast compensating plate 16 which gives the phase contrast of 14 or 90 polarizing plates, the liquid crystal layer 1, and the reflective film 8 at the liquid crystal cell 200, and light spread from the reflective film 8 to the polarizing plate 14, and carried out outgoing radiation of this conversely.

[0193] Consequently, it became clear by adjusting the refractive-index difference (deltan) of the liquid crystal of the liquid crystal layer 1, and a product (deltan-d) with liquid crystal thickness (d) for every twist angle of the liquid crystal layer 1 for a twist angle to be able to change the circular polarization of light into the perfect linearly polarized light within the limits of 0 times or more and 70 degrees or less. Moreover, although the circular polarization of light could

not be made into the perfect linearly polarized light by within the limits to 100 degrees more than 70 degrees, the good display found out the possible thing. and a twist angle [in / specific wavelength / by adjusting deltan-d of the liquid crystal layer 1 for every twist angle, when a twist angle makes 100% maximum in the visible wavelength of the reflection factor to 70 degrees] -- 97%, 83%, a twist angle becomes 72% and, as for the reflection factor in 80 degrees, a twist angle can obtain a good reflection factor for the reflection factor in 100 degrees, as for the reflection factor in 90 degrees However, if a twist angle exceeds 100 degrees, as for the reflection factor in 110 degrees, a twist angle will become unable [angle] for 54% and a twist angle to become 37% in the reflection factor in 120 degrees, and to polarize the circular polarization of light efficiently to the linearly polarized light, for example. That is, it is required to set up a twist angle within the limits of 0 times or more and 100 degrees or less in the liquid crystal layer 1 in the reflective display 9.
[0194] In addition, in an actual display, although the circular polarization of light was used for calculation in the above-mentioned explanation in order to evaluate a polarization conversion operation of the liquid crystal layer 1 in the reflective display 9, even if it is not necessary to necessarily carry out incidence of the circular polarization of light to the liquid crystal layer 1 of the reflective display 9, it designs as the liquid crystal layer 1 was mentioned above, and it carries out incidence of the linearly polarized light to this liquid crystal layer 1, a good display can be obtained by the reflective display 9.
[0195] On the other hand, in order to obtain a good display by the transparency display 10, liquid crystal orientation needs to be orientation with a small (0 times or more, 40 degrees or less) twist angle, or needs to be orientation with a large (60 degrees or more, 110 degrees or less) twist angle.
[0196] A polarization conversion operation required in order to obtain a good display by the transparency display 10 needs to fill a fundamental optical operation (the 1st condition) and the realistic optical operation (the 2nd condition) decided by relation of this fundamental optical operation (the 1st condition) and the reflective display 9.
[0197] In the case of for example, the 1st condition of the above, the reason is liquid crystal orientation (when an parallel orientation film is used) which has a polarization conversion operation. Set for it to be made [orientation / in / voltage / not impressing] substantial, and be, and in the liquid crystal layer 1 in the transparency display 10 A certain polarization (polarization with which are the linearly polarized light, the circular polarization of light, or elliptically polarized light, and the polarization state was specified to be) Polarization which is efficient and intersects perpendicularly with it (in the case of the circular polarization of light and elliptically polarized light which the hand of cut reversed when it was the linearly polarized light and the circular polarization of light the circular polarization of light and the field where the oscillating electric field of light are included cross at right angles in the case of the linearly polarized light, it is the elliptically polarized light of the same ovality the ovality and the ellipse main shaft direction crossed at right angles) It is because the operation changed into the elliptically polarized light which the hand of cut reversed is needed.
[0198] Then, although it asked for the polarization conversion operation by the above-mentioned calculus (the Jones matrix method) in order that an invention-in-this-application person etc. might evaluate the above-mentioned operation as a property required for the transparency display 10, if contrary to the range of a twist angle required for this reason, especially the limit became clear [that there is nothing].
[0199] Moreover, the 2nd condition of the above is restrictions produced in order to use the optical film by the side of the common screen (a polarizing plate 14 and phase contrast compensating plate 16) by the reflective display 9 and the transparency display 10 in this invention. The optical film in the reflective display 9 and the transparency display 10 is set up so that a reflective display may be performed good. And although a setup of a different optical film is possible in a field contrary to the screen of a liquid crystal display, as for this optical film, it is desirable to set it as arrangement which cooperates with the above-mentioned polarizing plate 14 and the phase contrast compensating plate 16 which are an optical film by the side of the screen, and the liquid crystal layer 1 by the side of the transparency display 10, and indicates the transparency display 10 good. In order to perform such a setup, it is only important for a polarization conversion operation of the liquid crystal layer 1 in the transparency display 10 it not only fulfills the 1st condition of the above, but that the circular polarization of light is convertible for the circular polarization of light of the circumference of reverse good or that the linearly polarized light is convertible for the linearly polarized light which intersects perpendicularly good.
[0200] Then, in order to evaluate the concrete conditions with which the 2nd condition of the above over the liquid crystal layer 1 in the transparency display 10 is filled, when incidence of the circular polarization of light was carried out to the liquid crystal layer 1, it asked for the luminous intensity which becomes the circular polarization of light of the circumference of reverse by the above-mentioned calculus. Calculation in addition, light As 1st phase contrast compensating plate which gives the phase contrast of 15 or 90 polarizing plates as the 1st polarizing plate It asked for the permeability at the time of spreading in order of the phase contrast compensating plate 16 as 2nd phase contrast

compensating plate which has the lagging axis which intersected perpendicularly with the 1st phase contrast compensating plate which gives the phase contrast of the ******** compensating plate 17 and 1 or 90 liquid crystal layers, and the polarizing plate 14 as the 1st polarizing plate of the above, and the 2nd polarizing plate which intersects perpendicularly.
[0201] Consequently, the invention-in-this-application person etc. found out that the circular polarization of light was changed into the circular polarization of light of the circumference of reverse good, when deltan-d of the liquid crystal layer 1 was adjusted for every twist angle and a twist angle was within the limits of 0 times or more and 40 degrees or less. When the permeability of the light in the visible wavelength at the time of zero twist angle is specifically made into 100%, The permeability of light in case 88.6% and the twist angle of the permeability of light in case a twist angle is 30 degrees are 40 degrees 80.8%, The permeability of light in case 72.0% and the twist angle of the permeability of light in case a twist angle is 50 degrees are 60 degrees becomes 62.4%, and when permeability estimates the polarization conversion operation which changes the circular polarization of light into the circular polarization of light of the circumference of reverse, permeability falls with increase of a twist angle. For this reason, the upper limit of a twist angle obtained the conclusion that setting to about 40 degrees was appropriate from the above-mentioned result.
[0202] Twist angles are arbitrary twist angles of 0 times or more, and a setup of the twist angle of the transparency display 10 which changes the linearly polarized light into the linearly polarized light which intersects perpendicularly efficiently on the other hand can realize fully efficient permeability, when the wavelength of light is limited to one wavelength. However, in order to obtain high permeability in the field where visible wavelength is large, an optimum value exists in a twist angle. When a twist angle is changed, deltan-d of the liquid crystal layer 1 was specifically adjusted so that 550nm which is the main wavelength of the visible wavelength range may become the maximum permeability, and the permeability of 550nm was made into 100%, it asked for the wavelength width of face except the upper limit and minimum of wavelength from which 90% or more of permeability is obtained. In addition, calculation of permeability is arranged so that, as for the transparency shaft of a polarizing plate 14-15, the liquid crystal orientation which exists in the center of the direction of thickness of the liquid crystal layer 1 when light passes the polarizing plate 14 as the polarizing plate 15 as the 1st polarizing plate of the above, the liquid crystal layer 1, the 1st polarizing plate, and the 2nd polarizing plate that intersects perpendicularly may make the angle of 45 degrees, and it is asking for the permeability at that time.
[0203] Wavelength width of face (wavelength range) in case a twist angle is 0 times Consequently, 230nm, Wavelength width of face in case 235nm and the twist angle of wavelength width of face in case a twist angle is 10 degrees are 20 degrees 240nm, Wavelength width of face in case 245nm and the twist angle of wavelength width of face in case a twist angle is 30 degrees are 40 degrees 250nm, Wavelength width of face in case 255nm and the twist angle of wavelength width of face in case a twist angle is 50 degrees are 60 degrees 265nm, Wavelength width of face in case 280nm and the twist angle of wavelength width of face in case a twist angle is 70 degrees are 80 degrees 310nm, Wavelength width of face in case 255nm and the twist angle of wavelength width of face in case 305nm and the twist angle of wavelength width of face in case 330nm and the twist angle of wavelength width of face in case a twist angle is 90 degrees are 100 degrees are 110 degrees are 120 degrees was set to 210nm.
[0204] From the above examination, permeability with a twist angle high within the limits of 60 degrees or more and 110 degrees or less was realized by latus wavelength width of face (wavelength range), the good polarization conversion operation was realized, and the bird clapper turned out that a good display was possible. Therefore, the twist angle of the liquid crystal of the transparency display 10 which fulfills the 2nd condition of the above is limited within the limits of 0 times or more and 40 degrees or less, or within the limits of 60 degrees or more and 110 degrees or less from the polarization conversion operation to the above circular polarization of light, and the polarization conversion operation to the linearly polarized light.
[0205] It became clear that the twist angle within the limits of 0 times or more and 40 degrees or less or within the limits of 60 degrees or more and 110 degrees or less gives a good display to the transparency display 10 as mentioned above at the reflective display 9 within the limits of 0 times or more and 100 degrees or less. That is, as a twist angle for obtaining a good display by both the reflective display 9 and the transparency display 10 as an example of the gestalt of operation of this invention, within the limits of 0 times or more and 40 degrees or less or within the limits of 60 degrees or more and 100 degrees or less is suitable.
[0206] In addition, in the example shown below, it sets for an example (an example 2 - an example 9, and example 11) with the equal twist angle of the liquid crystal layer 1 in the reflective display 9 and the transparency display 10. The typical example for which a twist angle uses the circular polarization of light at 0 times is an example 11 (liquid crystal orientation is perpendicular orientation), and the typical example for which a twist angle uses the linearly polarized light at 0 times is an example 3 (it is adjusting so that it may become the good Ming display by the phase contrast compensating plate). Moreover, the typical example for which a twist angle uses the linearly polarized light near 70

degrees is an example 5 (it is adjusting so that it may become the good Ming display by the phase contrast compensating plate).

[0207] According to examination mentioned above, the twist angle of the liquid crystal layer 1 for both obtaining a good display by the reflective display 9 and the transparency display 10 becomes within the limits of 0 times or more and 40 degrees or less, or within the limits of 60 degrees or more and 100 degrees or less.

[0208] In the above explanation, although the size of a twist angle was explained only about the positive sign, it cannot be overemphasized that the same argument is effective also about the negative sign (that to which the twist direction is twisted conversely) with the same absolute value.

[0209] When setting up a twist angle small, in any case, change of a polarization state becomes the function of the product (deltan-d) of a refractive-index difference (deltan) and liquid crystal thickness (d). And in the reflective display 9, since an incident light goes and comes back to the liquid crystal layer 1 and an incident light passes the liquid crystal layer 1 only at once in the transparency display 10, as for the liquid crystal thickness in the transparency display 10, it is desirable to be thickly set up as compared with the liquid crystal thickness in the reflective display 9.

[0210] In addition, also in TN liquid crystal display using the usual rotatory polarization, since it will be in the state where the rotatory polarization and change of the polarization state by the retardation are undistinguishable and generally uses elliptically polarized light for a display when liquid crystal thickness is thin, it is needless to say that it can use for the Ming display and dark display using the polarization conversion operation which mentioned above the rotatory polarization used in the above-mentioned TN liquid crystal display. The modulation of the transmitted light intensity by these rotatory polarization is also included in the polarization conversion operation in this invention.

[0211] furthermore, in the above-mentioned polarization conversion operation, for change of liquid crystal orientation to which a polarization state may be changed As mentioned above, whether the orientation state of liquid crystal is parallel to a substrate 4-5, or perpendicular like what [not only] is controlled but a surface passivation ferroelectric liquid crystal, or antiferroelectricity liquid crystal That from which only the direction of orientation changes while liquid crystal had maintained the orientation direction almost parallel to a substrate 4-5, and the thing to which an orientation direction is changed, using a pneumatic liquid crystal, changing electrode structure, and maintaining the direction of orientation of liquid crystal in a field parallel to the screen are also contained.

[0212] Moreover, in the above-mentioned liquid crystal display, the installation direction (pasting direction) of a polarizing plate 14-15 can be set up suitably. For example, what is necessary is just to appoint the installation direction of a polarizing plate 15 according to the installation direction of this polarizing plate 14, in order that the same polarizing plate 14 may act inevitably also to the display light which penetrates the transparency display 10, if the installation direction of a polarizing plate 14 is set up according to the reflective display 9.

[0213] As mentioned above, when liquid crystal orientation without a twist was used for a display and the reflective display 9 showed for example, a dark display, the dark display was shown similarly [the transparency display 10]. However, for example, if the installation direction of a polarizing plate 14 remains as it is and the installation direction of a polarizing plate 15 is changed 90 degrees, reversal of a display will take place by the reflective display 9 and the transparency display 10. That is, a good display is not obtained if it remains as it is. Then, in order to prevent reversal of such a display, the electrode which returned the installation direction of a polarizing plate 15, or became independent respectively to the reflective display 9 and the transparency display 10 may be given, the electric drive itself may be reversed by either the reflective display 9 or the transparency display 10, and the light and darkness of a display may be made in agreement.

[0214] Next, the display principle in the reflective display 9 and the transparency display 10 in the liquid crystal display shown in drawing 4 is further explained to a detail.

[0215] First, the display principle in the reflective display 9 is explained below. In addition, in order to simplify explanation, by the following explanation, the liquid crystal orientation of the liquid crystal layer 1 shall not have the twist by reflective display 9b and transparency display 10b, without using the phase contrast compensating plate 16-17. Furthermore, respectively, when light with a wavelength of 550nm penetrates the liquid crystal layer 1 only once, reflective display 9b and transparency display 10b so that it may have 1/4 wave and 1/2 wave of phase contrast The thickness of the reflective display 9 and the transparency display 10 shall be adjusted, a liquid crystal constituent shall have a positive dielectric constant anisotropy, the liquid crystal orientation in [voltage] not impressing shall be parallel in general to a substrate 4-5, and the orientation direction shall make the angle of 45 degrees to the absorption shaft direction of a polarizing plate 14.

[0216] In this case, the liquid crystal orientation in the reflective display 9 and the transparency display 10 in voltage the state where it does not impress turns into liquid crystal orientation shown in reflective display 9b and transparency display 10b, and the liquid crystal orientation in the reflective display 9 and the transparency display 10 which changed with impression of voltage turns into liquid crystal orientation shown in reflective display 9a and transparency display

10a.

[0217] As for the refractive-index difference (deltan) of a liquid crystal constituent, and the product (deltan-d) with liquid crystal thickness (d), 1/4-wave conditions are satisfied in above-mentioned reflective display 9b. For this reason, in the case of incidence, an ambient light turns into the linearly polarized light with a polarizing plate 14, and further, when reaching the reflective film 8 by the retardation of the liquid crystal layer 1, it turns into the circular polarization of light. At this time, travelling direction reverses an incident light by the reflective film 8, and the circular polarization of light turns into the circular polarization of light which intersected perpendicularly to the polarization at the time of incidence, i.e., the circular polarization of light which right and left reversed, in order that the hand of cut of oscillating electric field may be saved and only travelling direction may be reversed. This circular polarization of light passes the liquid crystal layer 1 of reflective display 9b again, turns into the linearly polarized light parallel to the absorption shaft direction of a polarizing plate 14, is absorbed with a polarizing plate 14 and serves as a dark display.

[0218] Moreover, as for the refractive-index difference (deltan) of a liquid crystal constituent, and the product (deltan-d) with liquid crystal thickness (d), in transparency display 10b, 1/2-wave conditions are satisfied at this time. For this reason, the liquid crystal layer 1 has the operation which changes into an axial symmetry the direction of the plane of vibration of the linearly polarized light which carried out incidence to the direction of liquid crystal orientation. Therefore, it is determined that the absorption shaft direction of the polarizing plate 15 by the side of the incidence of the light to transparency display 10b will become the transparency shaft direction of a polarizing plate 14 and a polarizing plate 15 and parallel as the light which passes a polarizing plate 14 is absorbed with a polarizing plate 14 and serves as a dark display in response to the operation which the liquid crystal layer 1 mentioned above.

[0219] Thus, when those transparency shaft directions had been arranged so that a polarizing plate 14 and a polarizing plate 15 might make the angle this transparency shaft direction to parallel and whose liquid crystal orientation are 45 degrees, the bird clapper found both reflective display 9b and transparency display 10b at the dark display.

[0220] Next, the operation at the time of changing the orientation state of liquid crystal from voltage the state where it does not impress (initial orientation state of liquid crystal) shown in above-mentioned reflective display 9b and transparency display 10b to a perpendicular mostly to the screen by giving the potential difference to an electrode 6 and an electrode 7, as shown in reflective display 9a and transparency display 10a is explained below.

[0221] In this case, outgoing radiation is carried out from a polarizing plate 14, with the direction of the linearly polarized light which passed again the liquid crystal layer 1 after it reaches the reflective film 8, without a polarization state changing, as for an incident light since an ambient light turns into the linearly polarized light with a polarizing plate 14 in reflective display 9a and the liquid crystal layer 1 does not have a retardation to the linearly polarized light and travelling direction is further reversed, and intersected perpendicularly with the absorption shaft direction of a polarizing plate 14 maintained.

[0222] Moreover, it passes through a polarizing plate 14 also in transparency display 10a, an incident light's turning into the linearly polarized light, and maintaining the direction of the linearly polarized light in general with a polarizing plate 15, like reflective display 9a.

[0223] When using the polarization conversion operation by the above optical anisotropies for a display, liquid crystal is carrying out parallel orientation of the amount of this polarization conversion operation, and when voltage is not impressed to the liquid crystal layer 1, it is determined by the product (deltan-d) of the twist angle of the orientation of the liquid crystal layer 1, and a liquid crystal thickness (d) and the refractive-index difference (deltan) of a liquid crystal constituent. For this reason, like this invention, in the liquid crystal display which uses the transmitted light and the reflected light for a display, it is effective that the transparency display 10 has liquid crystal thickness thicker than the reflective display 9 in order to reconcile the lightness and the contrast ratio of a display by both the reflective display 9 and the transparency display 10. In addition, twist angles may differ respectively by the reflective display 9 and the transparency display 10.

[0224] Moreover, when the above-mentioned liquid crystal display is equipped with the phase contrast compensating plate 16-17, to the light of two or more wavelength of a light region, sufficient lightness and a sufficient contrast ratio can be secured, consequently a still better display can be realized.

[0225] Moreover, even if the liquid crystal constituent and orientation of the liquid crystal layer 1 are the same as that of the above-mentioned explanation, it is possible to reverse change of the above-mentioned display by operation of the phase contrast compensating plate 16-17. If 1/4 wavelength plate is used, for example as a phase contrast compensating plate 16-17, that is, in reflective display 9b An ambient light becomes the liquid crystal layer 1 by the phase contrast compensating plate 16 at the circular polarization of light in the case of incidence, and further by the polarization conversion operation by the optical anisotropy of the liquid crystal layer 1 When reaching the reflective film 8, after it becomes the linearly polarized light and travelling direction is reversed with the reflective film 8, Since it is again changed into the transparency component of a polarizing plate 14 and outgoing radiation is carried out from

a polarizing plate 14, it becomes the Ming display, and as shown in reflective display 9a, when liquid crystal orientation changes, since an ambient light reaches the reflective film 8 with the circular polarization of light, it becomes a dark display.

[0226] Moreover, although the above-mentioned explanation explained the case where a display changed from a dark display to the Ming display, with the increase in the potential difference of an electrode 6 and an electrode 7, change of this display can be reversed by making negative the dielectric constant anisotropy of the liquid crystal constituent used for the liquid crystal layer 1, and making the initial orientation state of liquid crystal into perpendicular orientation, as it is not limited to this and mentioned above.

[0227] Here, in setting the initial orientation state of liquid crystal as perpendicular orientation, it has the technical feature that a polarization conversion operation of initial orientation is not greatly influenced by the production precision of liquid crystal thickness. Therefore, it may become the high means of mass-production nature to assign an initial orientation state to a black display so that the black display which influences display grace greatly to an energize sake may be stabilized in this feature. In order to realize especially this, after the polarization conversion operation of the liquid crystal layer 1 which carried out orientation perpendicularly has disappeared mostly, it is necessary to give an indication black, and a good circular polarization of light-ized operation is required for the phase contrast compensating plate 16. That is, it is important to have composition which serves as the circular polarization of light on latus wavelength as much as possible as a phase contrast compensating plate 16.

[0228] Moreover, the transparency display 10 serves as a dark display by the liquid crystal orientation shown in the Ming display and transparency display 10a according to the liquid crystal orientation shown in transparency display 10b, when being arranged so that it may have the absorption shaft direction where it is arranged in so that it may have the lagging-axis direction where the phase contrast compensating plate 17 and the phase contrast compensating plate 16 intersect perpendicularly, and a polarizing plate 14 and a polarizing plate 15 intersect perpendicularly mutually.

[0229] Even if the orientation of the liquid crystal layer 1 is which [of parallel orientation and perpendicular orientation] case, when it changes liquid crystal thickness by the reflective display 9 and the transparency display 10 in the liquid crystal display concerning this invention, by the reflective display 9 and the transparency display 10 In order to reconcile lightness and a contrast ratio It displays, when the light which carried out incidence through the liquid crystal layer 1 from the screen side carries out outgoing radiation to a screen side through the liquid crystal layer 1 in the reflective display 9 again, as mentioned above. in the transparency display 10 When the light which carried out incidence from the tooth-back side (back light 13 side) passes the liquid crystal layer 1 only at once, and carries out outgoing radiation to a screen side and it displays It is effective that the liquid crystal thickness in the transparency display 10 is set up more thickly than the liquid crystal thickness in the reflective display 9, and satisfies the above-mentioned conditions as the result.

[0230] Although a concrete example and the example of comparison are given and explained with reference to drawing 4 - drawing 8 about the liquid crystal display which uses change of the polarization state by polarization conversion operation of the liquid crystal layer 1 for a display among the liquid crystal displays concerning the gestalt of this operation hereafter using a polarizing plate 14-15, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.

[0231] [An example 2 - example 4] In the example 2 - the example 4, the liquid crystal cell for liquid crystal pouring which has the liquid crystal thickness (d) whose reflective display 9 the transparency display 10 is 7.5 micrometers and is 4.5 micrometers was produced by the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method. That is, also in the example 2 - the example 4, by a sensitization resin's not remaining in the transparency display 10, but carrying out pattern formation of the insulator layer 11 so that it may be formed in the thickness this sensitization resin of whose is 3 micrometers in the reflective display 9, in the transparency display 10, liquid crystal thickness set up rather than the reflective display 9 so that it might become thick. However, in the example 2 - the example 4, as shown in drawing 4 , the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that voltage might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.

[0232] Furthermore, in the example 2 - the example 4, the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal pouring is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a positive dielectric constant anisotropy by the vacuum pouring-in method.

[0233] And the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the liquid crystal cell obtained by doing in this way, and the liquid crystal display was produced. At this time, examples 2-4 constituted the phase contrast compensating plate 17 from the phase contrast

compensating plate of two sheets, and in the example 3, the phase contrast compensating plate 16 was constituted from a phase contrast compensating plate of one sheet, and consisted of examples 2-4 at the phase contrast compensating plate of two sheets. The pasting direction of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation direction).
[0234] Moreover, in the example 2, liquid crystal orientation was made into homogeneous orientation, and used NB (normally black) mode for the display. In the example 3, liquid crystal orientation was made into homogeneous orientation, and used NW (normally white) mode for the display. And in the example 4, what mixed these (NB mode is used for a reflective display and NW mode is used for a transparency display) was used.
[0235] However, in the above-mentioned example 2 - the example 4, when not impressing voltage, while using the orientation film of an parallel stacking tendency for the orientation film 2-3, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed, so that liquid crystal might carry out orientation in parallel with the screen.
[0236] As it is indicated in drawing 5 as a rubbing crossed axes angle, it sets to the liquid crystal cell for liquid crystal pouring here. It is based on the rubbing direction X which is an orientation processing direction of the orientation film 2 (namely, orientation film 2 by the side of a substrate 4) in the electrode substrate which is an observer side substrate among the electrode substrates of the couple which pinches the liquid crystal layer 1. It is defined as the angle which measured the rubbing direction Y which is an orientation processing direction of the orientation film 3 (namely, orientation film 3 by the side of a substrate 5) in the electrode substrate of another side to the circumference of an anti-clock.
[0237] The orientation state of the liquid crystal molecule in the liquid crystal layer 1 currently pinched with the orientation film 2-3 by which orientation processing was carried out is determined by the stacking tendency of the orientation film 2-3, the addition of the chiral additive which gives the twist peculiar to liquid crystal, and the rubbing crossed axes angle when electric field, a magnetic field, etc. do not exist.
[0238] When a rubbing crossed axes angle is 180 degrees, orientation of the liquid crystal constituent with which the chiral additive is not mixed is carried out without twisting. Moreover, orientation of the liquid crystal layer 1 is carried out without twisting, and if a certain constant rate is exceeded, twist orientation (180-degree left twist orientation) of it will be carried out to counterclockwise twining 180 degrees, until the addition of a chiral additive reaches a certain constant rate, when a chiral additive carries out induction of the twist of a left twist to liquid crystal. And if the addition of the above-mentioned chiral additive is increased further, 180 twists of only an integral multiple will be realized according to the increase in a chiral additive.
[0239] Therefore, the orientation direction of the liquid crystal on the orientation film 3 realized with the rubbing crossed axes angle (180 degrees) mentioned above in the gestalt of this operation When you increase the quantity of a chiral additive x times when not adding a chiral additive, in making into x times the rubbing direction X of the orientation film 2 arranged on the electrode substrate of the liquid crystal layer 1 top, and you are twisting on the left 180 degrees between up-and-down electrode substrates, suppose that it is expressed as a degree (180+x).
[0240] In addition, it is the so-called parallel orientation film to which the orientation film 2-3 carries out orientation of the liquid crystal in parallel to an orientation film surface in such orientation processing. When the dielectric constant anisotropy in which the chiral additive is not mixed uses a positive pneumatic liquid crystal When not impressing voltage, a liquid crystal molecule is almost parallel to the electrode substrate of the upper and lower sides whose liquid crystal layer 1 is pinched, and takes an orientation (namely, homogeneous orientation) state without a twist, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of voltage according to voltage.
[0241] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in each liquid crystal display obtained in the example 2 - the example 4, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 1 using the criteria of a common direction in each example.
[0242] In addition, the optical arrangement shown in Table 1 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, each phase contrast compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.
[0243] Moreover, since the liquid crystal layer 1 has taken the orientation which is not twisted, although the orientation direction (orientation direction of a liquid crystal molecule major axis) of the liquid crystal layer 1 whole at the time of no voltage impressing is indicated, this orientation direction is a direction of the orientation processing performed to the orientation film 2 by the side of a substrate 4.

[0244] In addition, each direction expresses with the unit of a degree the direction from the criteria direction arbitrarily taken on the screen, and the retardation (namely, product of the refractive-index difference within the field of a phase contrast compensating plate and thickness) of each phase contrast compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0245]
[Table 1]

			実施例２	実施例３	実施例４
偏光板１４		透過軸方位　（度）	0	0	0
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１５	１５	１５
		リタデーション（nm）	２７０	２７０	２７０
	位相差補償板	遅相軸方位　（度）	１６５	なし	１６５
		リタデーション（nm）	１３５	なし	１３５
液晶層１		配向方位　（度）	７５	７５	７５
位相差補償板１７	位相差補償板	遅相軸方位　（度）	１６５	１６５	１６５
		リタデーション（nm）	７０	２２０	９０
	位相差補償板	遅相軸方位　（度）	１３５	１３５	１０５
		リタデーション（nm）	２７０	２７０	２７０
偏光板１５		透過軸方位　（度）	６０	６０	９０

[0246] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 2, the example 3, and the example 4 is respectively shown in drawing 6 , drawing 7 , and drawing 8 . In addition, each of these display properties is measured by the same method as an example 1, a horizontal axis shows the actual value of applied voltage in each above-mentioned drawing, and a vertical axis shows lightness (a reflection factor or permeability). Moreover, the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is stuck is made into 100% of permeability, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.
[0247] In drawing 6 , a curve 211 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 2, and a curve 212 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 2.
[0248] As shown in drawing 6 , in the example 2, both a reflection factor and permeability are rising with elevation of applied voltage in the section whose applied voltage is 1V-2V. Moreover, both the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V, and the permeability of the transparency display 10 were 40%.
[0249] Moreover, in drawing 7 , a curve 221 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3, and a curve 222 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3.
[0250] As shown in drawing 7 , in the example 3, both a reflection factor and permeability are decreasing with elevation of applied voltage in the section whose applied voltage is 1V-2V. Moreover, both the reflection factor of the reflective display 9 in case applied voltage is 1V, and the permeability of the transparency display 10 were 40%, and

the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 2V was 2% 3%.

[0251] Moreover, in drawing 8 , a curve 231 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4, and a curve 232 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4.

[0252] As shown in drawing 8 , while a reflection factor rises with elevation of applied voltage, in the example 4, permeability is decreasing in the section whose applied voltage is 1V-2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 40% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V was 2% 40%.

[0253] As mentioned above, all, permeability and a reflection factor change with the change of applied voltage to this liquid crystal display, and both the reflective display and the transparency display were possible for the liquid crystal display obtained in the above-mentioned example 2 - the example 4.

[0254] Furthermore, when visual observation is carried out, it sets in an example 2 and the example 3. By impressing the same voltage to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 Since it displayed by the electrode 6 and the electrode 7 by keeping the same the voltage applied to the liquid crystal layer 1 by the reflective display 9 and the transparency display 10, change of light and darkness is the same at the reflective display 9 and the transparency display 10, and it checked that reversal of the light and darkness of a display did not arise. Moreover, even if it is in the middle of observation and changed the intensity of an ambient light in the case of this display, change of the content of a display was not seen. That is, when the reflective display 9 was a dark display, the transparency display 10 also became a dark display, and when the reflective display 9 was the Ming display, the transparency display 10 also became the Ming display. For this reason, reversal of a display was not produced when it drove at the reflective display 9 and the transparency display 10 using the same electrode 7 like a publication to aforementioned drawing 1 .

[0255] On the other hand, in the example 4, when voltage was impressed like an example 2 and an example 3 (i.e., when the voltage of 1V is impressed), the transparency display 10 became the Ming display and the reflective display 9 became a dark display. Moreover, when the voltage of 2V was impressed, the transparency display 10 became a dark display and the reflective display 9 became the Ming display. For this reason, the light and darkness of a display were reversed by the transparency display 10 and the reflective display 9. When it displayed in the weak environment of an ambient light, and the transparency display 10 was mainly being observed for this reversal, the ambient light was strengthened and the reflective display was performed, the light and darkness of a display were reversed and difficulty was produced in the check of the content of a display. As shown in an example 4, when the same voltage was impressed from this to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 and it was the mixed mode of NB and NW, reversal of a display was large and the thing of the reflective display 9 and the transparency display 10 for which visibility is worsened was checked.

[0256] So that the transparency display 10 may also serve as the Ming display and the transparency display 10 may also serve as a dark display simultaneous when the reflective display 9 is a dark display simultaneous when the reflective display 9 is the Ming display in an example 4 on the other hand Different voltage to the electrode 7 in the reflective display 9 and the electrode 7 in the transparency display 10 is impressed. that is, when impressing the voltage (1V) this reflective display 9 indicates a dark display to be to the reflective display 9 by the electrode 6-7 (orientation mechanism) When impressing the voltage (2V) from which this transparency display 10 serves as a dark display to the transparency display 10 and impressing the voltage (2V) from which this reflective display 9 serves as the Ming display at the reflective display 9 By impressing the voltage (1V) from which this transparency display 10 serves as the Ming display to the transparency display 10, reversal of the light and darkness of a display was solved and the same good display state as an example 2 and an example 3 was acquired.

[0257] The above thing shows that each liquid crystal display of the above-mentioned example 2 - an example 4 can realize the display which could make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10, and was excellent in visibility while each was [as opposed to / the transparency display 10 / both] compatible in the lightness and the contrast ratio of the Ming display also to the reflective display 9. Moreover, it turns out that each of each liquid crystal displays of the above-mentioned example 2 - an example 4 can raise display grace further, and can perform a good display from the contrast ratio in the transparency display 10 exceeding the contrast ratio in the reflective display 9.

[0258] Next, although a concrete example and the example of comparison are given and explained with reference to drawing 9 and drawing 10 about the liquid crystal display which uses a polarization conversion operation of the liquid

crystal layer 1 by the twist orientation of the liquid crystal layer 1 for a display among the liquid crystal displays concerning the gestalt of this operation, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0259] [Example 5] In this example, the liquid crystal cell for liquid crystal pouring which has the liquid crystal thickness whose reflective display 9 the transparency display 10 is 7.5 micrometers and is 4.5 micrometers was produced by the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method. That is, also in this example, by a sensitization resin's not remaining in the transparency display 10, but carrying out pattern formation of the insulator layer 11 so that it may be formed in the thickness this sensitization resin of whose is 3 micrometers in the reflective display 9, in the transparency display 10, liquid crystal thickness set up rather than the reflective display 9 so that it might become thick.
[0260] However, in this example, like examples 2-4, as shown in drawing 4 , the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that voltage might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.
[0261] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. The pasting direction of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation direction).
[0262] At this example, it is the twist orientation (the liquid crystal display was produced so that the twist angle (twist angle) of the orientation of liquid crystal might become 70 degrees.) of the liquid crystal layer 1. Specifically, orientation processing was performed using the orientation film of an parallel stacking tendency by performing rubbing processing so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing voltage to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal pouring, when a refractive-index difference (deltan) introduced the liquid crystal constituent which has the positive dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. By operation of the chiral additive added to such orientation processing and the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. Thus, according to voltage, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of voltage from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.
[0263] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 2 using the criteria of a common direction.
[0264] [Example 6] this example as well as an example 5 produced the liquid crystal cell for liquid crystal pouring which has the liquid crystal thickness (d) whose reflective display 9 the transparency display 10 is 7.5 micrometers and is 4.5 micrometers by the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method. Moreover, as shown in drawing 4 , the electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically, and the electrode pattern was produced so that voltage might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside.
[0265] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, in this example, the phase contrast compensating plate of one sheet was respectively used for the phase contrast compensating plate 16 and the phase contrast compensating plate 17. The pasting direction of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation direction).
[0266] In this example, the liquid crystal display was produced so that the twist orientation (twist angle of the orientation of liquid crystal (twist angle)) of the liquid crystal layer 1 might become 90 degrees. Specifically, orientation processing was performed using the orientation film of an parallel stacking tendency by performing rubbing processing so that the rubbing crossed axes angle may become 270 degrees so that the liquid crystal orientation when not impressing voltage to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed

axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal pouring, when a refractive-index difference (deltan) introduced the liquid crystal constituent which has the positive dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. By operation of the chiral additive added to such orientation processing and the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 90 degrees. Thus, according to voltage, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of voltage from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.

[0267] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 2 using the criteria of a common direction.

[0268] In addition, the optical arrangement shown in Table 2 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, each phase contrast compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.

[0269] Moreover, the orientation direction (orientation direction of a liquid crystal molecule major axis) of the liquid crystal layer 1 is equal to the direction of the rubbing processing performed to the orientation film 2 by the side of a substrate 4 in a substrate 4 side, and equal to the direction of the rubbing processing performed to the orientation film 3 by the side of a substrate 5 in a substrate 5 side. However, when the orientation direction of the liquid crystal which touches the orientation film 2 is pursued to the orientation film 3 side, 90 left twist orientation is carried out. Thus, when liquid crystal orientation is pursued and the rubbing processing direction to the orientation film 2 is considered to be an orientation direction by the side of a substrate 4 (for it to be hereafter written as a substrate 4 orientation direction), the rubbing direction of the orientation film 3 turns into a direction which reversed the direction which pursued the orientation of liquid crystal according to the twist 180 degrees. Hereafter, the orientation direction by the side of a substrate 5 (it is hereafter written as a substrate 5 orientation direction) is defined as liquid crystal orientation on the substrate 5 which pursued the orientation of liquid crystal according to the twist from the substrate 4 orientation direction.

[0270] In addition, each direction in Table 2 expresses with the unit of a degree the direction from the criteria direction arbitrarily taken on the screen, and the retardation of each phase contrast compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.

[0271]

[Table 2]

			実施例5	実施例6
偏光板14		透過軸方位 (度)	0	0
位相差補償板16	位相差補償板	遅相軸方位 (度)	18	12
		リタデーション (nm)	270	135
	位相差補償板	遅相軸方位 (度)	126	なし
		リタデーション (nm)	135	なし
液晶層1		基板4配向方位 (度)	16	−11
		基板5配向方位 (度)	86	79
位相差補償板17	位相差補償板	遅相軸方位 (度)	−4	135
		リタデーション (nm)	260	260
偏光板15		透過軸方位 (度)	152	90

[0272] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 5 and the example 6 is respectively shown in drawing 9 and drawing 10 . In addition, each of these display properties is measured by the same method as an example 1, a horizontal axis shows the actual value of applied voltage in each above-mentioned drawing, and a vertical axis shows lightness (a reflection factor or permeability). Moreover, the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is stuck is made into 100% of permeability, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.
[0273] In drawing 9 , a curve 241 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5, and a curve 242 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5.
[0274] As shown in drawing 9 , in the example 5, both a reflection factor and permeability are rising [applied voltage] with elevation of applied voltage in the section beyond 1.2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 4V was 40% 41%.
[0275] Moreover, in drawing 10 , a curve 251 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 6, and a curve 252 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 6.
[0276] As shown in drawing 10 , both a reflection factor and permeability are rising [applied voltage] with the rise of applied voltage in the example 6 as well as an example 5 in the section beyond 1.2V. Moreover, in the example 6, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 2% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 4V was 37% 35%.
[0277] As mentioned above, all, permeability and a reflection factor change with the change of applied voltage to this liquid crystal display, and both the reflective display and the transparency display were possible for the liquid crystal display obtained in the above-mentioned example 5 and the example 6.
[0278] Furthermore, when visual observation is carried out, it sets in an example 5 and the example 6. By impressing the same voltage to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 When

displaying by the electrode 6 and the electrode 7 by keeping the same the voltage applied to the liquid crystal layer 1 by the reflective display 9 and the transparency display 10, change of light and darkness is the same at the reflective display 9 and the transparency display 10, and it checked that reversal of the light and darkness of a display did not arise. Moreover, even if it is in the middle of observation and changed the intensity of an ambient light in the case of this display, change of the contents of a display was not seen. That is, when the reflective display 9 was a dark display, the transparency display 10 also became a dark display, and when the reflective display 9 was the Ming display, the transparency display 10 also became the Ming display. For this reason, in the above-mentioned example 5 and the example 6, when it drove at the reflective display 9 and the transparency display 10 using the same electrode 7 like a publication to aforementioned drawing 1 , reversal of a display was not produced.

[0279] Therefore, all, each liquid crystal display of the above-mentioned example 5 and an example 6 can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while it is [as opposed to / the transparency display 10 / both] compatible in the lightness and the contrast ratio of the Ming display also to the reflective display 9, and it can realize the display excellent in visibility. Moreover, from the contrast ratio in the transparency display 10 exceeding the contrast ratio in the reflective display 9, each of each liquid crystal displays of the above-mentioned example 5 and an example 6 can raise display grace further, and can realize a good display.

[0280] Moreover, an example 6 has little number of sheets of the phase contrast compensating plate used as compared with an example 5, and the liquid crystal display which is excellent in visibility and uses for a display both the reflected lights and transmitted lights in which a high resolution color display (color display) is possible can be offered more cheaply.

[0281] With the gestalt of the above operation, by changing liquid crystal thickness by the reflective display and the transparency display explained the liquid crystal display which performs a good reflective display and a good transparency display. The following explanation explains the liquid crystal display which sets up and performs a good reflective display and a good transparency display so that the liquid crystal thickness in a reflective display and the liquid crystal thickness in a transparency display may become equal.

[0282] [Gestalt 3 of operation] With the gestalt of this operation, when the liquid crystal thickness in a reflective display and the liquid crystal thickness in a transparency display are equal, the liquid crystal display which realizes a good reflective display and a good transparency display is explained by changing the voltage which carries out a seal of approval by the reflective display and the transparency display, and changing liquid crystal orientation by the reflective display and the transparency display.

[0283] With the gestalt of this operation, the polarizing plate 14-15 of a publication is used for the gestalt 2 of the aforementioned implementation, the case where it sets up in the liquid crystal display which uses the retardation of the liquid crystal layer 1 for a display so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10 is mentioned as an example, and such a liquid crystal display is explained using a concrete example and the example of comparison with reference to drawing 4 and drawing 11 - drawing 16 . However, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.

[0284] In addition, the same number is given to the component which has the function as the gestalt 1 of the aforementioned implementation, and the gestalt 2 of operation of explanation same for convenience, and the explanation is omitted. Moreover, about the concrete whole composition of the liquid crystal display concerning the gestalt of this operation, since it is the same as that of the gestalt 2 of the aforementioned implementation except being set up so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10, the explanation is omitted here.

[0285] What is necessary is just to form an electrode 7 directly on a substrate 5, without forming the insulator layer 11 formed on the aforementioned substrate 5, in order to set up so that liquid crystal thickness may become equal by the reflective display 9 and the transparency display 10 as shown in the gestalt of this operation.

[0286] [Example 7] As the insulator layer 11 which consists of a sensitization resin which has insulation is not formed on a substrate 5 in an example 1 in this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that voltage might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal pouring which both has 4.5-micrometer liquid crystal thickness (d).

[0287] And the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal pouring is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a positive dielectric constant anisotropy by the

vacuum pouring-in method.
[0288] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, at this example, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate 16 consisted of phase contrast compensating plates of two sheets. The pasting direction of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation direction).
[0289] In this example, while using the liquid crystal layer in which liquid crystal carries out orientation to parallel (parallel to the screen) and which has not carried out twist orientation to the liquid crystal layer 1 to the substrate 4-5, the birefringence mode in which the retardation of the liquid crystal layer 1 was used for a display was used as a liquid crystal display method.
[0290] Moreover, the retardation suitable for the reflective display was used for the transparency display 10 in this example. Here, although the reflective display 9 is set up like the reflective display 9 of the example 2 in the gestalt 2 of the aforementioned implementation, the liquid crystal thickness is equal to the reflective display 9, and it is set up by the transparency display 10, and differ in the example 2. For this reason, in this example, in an example 2, again, the optical design was performed and optical arrangement of a polarizing plate 14-15 and optical arrangement of the phase contrast compensating plate 16-17 are determined. In this example, optical arrangement of these polarizing plates 14-15 and the phase contrast compensating plate 16-17 was set up so that the dark display of the transparency display 10 might be good.
[0291] Moreover, in this example, while using the orientation film of an parallel stacking tendency for the orientation film 2-3 like the aforementioned example 2 so that liquid crystal might carry out orientation in parallel with the screen when not impressing voltage, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed. In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of voltage according to voltage.
[0292] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 3 using the criteria of a common direction.
[0293] [Example 3 of comparison] Here, the example of comparison of the above-mentioned example 7 is shown. In this example 3 of comparison, in the liquid crystal display shown in an example 7, while the phase contrast compensating plate 16 was constituted from a phase contrast compensating plate of two sheets, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having set up optical arrangement of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 so that the Ming display of the transparency display 10 might be good. The pasting direction of the above-mentioned phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation direction).
[0294] Moreover, also in this example of comparison, while using the orientation film of an parallel stacking tendency for the orientation film 2-3 like the aforementioned example 7 so that liquid crystal might carry out orientation in parallel with the screen when not impressing voltage, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed. In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of voltage according to voltage.
[0295] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained in this example of comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 3 using the criteria of a common direction.
[0296] [Example 8] In the liquid crystal display shown in an example 7 by this example The liquid crystal thickness (d) in the reflective display 9 and the liquid crystal thickness (d) in the transparency display 10 are both 7.5 micrometers. The retardation suitable for the transparency display was used for the reflective display 9, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having set up optical arrangement of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 so that a reflective display might be good.
[0297] As the insulator layer 11 which consists of a sensitization resin which has insulation is not more specifically

formed on a substrate 5 in an example 1 by this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that voltage might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal pouring which both has 7.5-micrometer liquid crystal thickness (d).
[0298] And the refractive-index difference (deltan) of the liquid crystal constituent which does not contain a chiral agent in the liquid crystal cell for the above-mentioned liquid crystal pouring is 0.065, and the liquid crystal layer 1 was formed by introducing the liquid crystal constituent which has a positive dielectric constant anisotropy by the vacuum pouring-in method.
[0299] The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, at this example, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate 16 consisted of phase contrast compensating plates of two sheets. The pasting direction of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation direction).
[0300] In this example, while using the liquid crystal layer in which liquid crystal carries out orientation to parallel (parallel to the screen) and which has not carried out twist orientation to the liquid crystal layer 1 to the substrate 4-5, the birefringence mode in which the retardation of the liquid crystal layer 1 was used for a display was used as a liquid crystal display method.
[0301] Moreover, the retardation suitable for the transparency display was used for the reflective display 9 in this example. Here, although the transparency display 10 is set up like the transparency display 10 of the example 2 in the form 2 of the aforementioned implementation, the liquid crystal thickness is equal to the transparency display 10, and it is set up by the reflective display 9, and differ in the example 2. For this reason, in this example, in an example 2, again, the optical design was performed and optical arrangement of a polarizing plate 14-15 and optical arrangement of the phase contrast compensating plate 16-17 are determined. In this example, optical arrangement of these polarizing plates 14-15 and the phase contrast compensating plate 16-17 was set up so that a reflective display might be good.
[0302] Moreover, in this example, while using the orientation film of an parallel stacking tendency for the orientation film 2-3 like the aforementioned example 2 so that liquid crystal might carry out orientation in parallel with the screen when not impressing voltage, the rubbing crossed axes angle of the orientation film 2-3 was set as 180 degrees, and orientation processing was performed. In such orientation processing, the twist angle (twist angle) of the orientation of liquid crystal is 0 times, and orientation change produces it from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1 with impression of voltage according to voltage.
[0303] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 3 using the criteria of a common direction.
[0304] In addition, the optical arrangement shown in Table 3 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, each phase contrast compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side.
[0305] Moreover, since the liquid crystal layer 1 has taken the orientation which is not twisted, although the orientation direction (orientation direction of a liquid crystal molecule major axis) of the liquid crystal layer 1 whole at the time of no voltage impressing is indicated, this orientation direction is a direction of the rubbing processing performed to the orientation film 2 by the side of a substrate 4.
[0306] In addition, each direction expresses with the unit of a degree the direction from the criteria direction arbitrarily taken on the screen, and the retardation of each phase contrast compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0307]
[Table 3]

			実施例7	比較例3	実施例8
偏光板１４		透過軸方位　（度）	0	0	0
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１５	１５	１５
		リタデーション（nm）	２７０	２７０	２７０
	位相差補償板	遅相軸方位　（度）	１６５	１６５	１６５
		リタデーション（nm）	１３５	１３５	１３５
液晶層１		配向方位　（度）	７５	７５	７５
位相差補償板１７	位相差補償板	遅相軸方位　（度）	７５	１０５	１６５
		リタデーション（nm）	１３５	２７０	７０
	位相差補償板	遅相軸方位　（度）	１３５	なし	１３５
		リタデーション（nm）	２７０	なし	２７０
偏光板１５		透過軸方位　（度）	６０	0	６０

[0308] [Example 4 of comparison] In the liquid crystal display shown in an example 7 in this example of comparison Liquid crystal carries out orientation to the liquid crystal layer 1 to a substrate 4-5 at parallel (parallel to the screen). And the liquid crystal layer which carried out twist orientation 70 degrees was used, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display.
[0309] As the insulator layer 11 which consists of a sensitization resin which has insulation is not more specifically formed on a substrate 5 in an example 1 in this example of comparison and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that voltage might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal pouring which both has 4.5-micrometer liquid crystal thickness (d).
[0310] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, in this example of comparison, while constituting the phase contrast compensating plate 17 from a phase contrast compensating plate of two sheets, the phase contrast compensating plate 16 consisted of phase contrast compensating plates of two sheets. The pasting direction of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation direction).
[0311] Furthermore, in this example of comparison, orientation processing was performed by performing rubbing processing using the orientation film of an parallel stacking tendency, so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing voltage to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal pouring, when a refractive-index difference (deltan) introduced the liquid crystal constituent which has the positive dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. By operation of the chiral additive added to such orientation processing and the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. In addition, the above-mentioned chiral

additive is adjusting the addition so that the above-mentioned twist angle may be acquired. Thus, according to voltage, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of voltage from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.
[0312] Moreover, in this example of comparison, the refractive-index difference (deltan) of the liquid crystal constituent suitable for the reflective display and the product (deltan-d) with liquid crystal thickness (d) were used for the transparency display 10. Here, although the reflective display 9 is set up like the reflective display 9 of the example 5 in the gestalt 2 of the aforementioned implementation, the liquid crystal thickness is equal to the reflective display 9, and it is set up by the transparency display 10, and differ in the example 5. For this reason, in this example of comparison, in an example 5, again, the optical design was performed and optical arrangement of a polarizing plate 14-15 and optical arrangement of the phase contrast compensating plate 16-17 are determined. In this example of comparison, optical arrangement of these polarizing plates 14-15 and the phase contrast compensating plate 16-17 was set up so that the dark display of the transparency display 10 might be good.
[0313] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained in this example of comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 4 using the criteria of a common direction.
[0314] [Example 5 of comparison] In this example of comparison, the liquid crystal display shown in the example 4 of comparison and the liquid crystal display designed similarly were produced in the liquid crystal display shown in the example 4 of comparison except having set up a polarizing plate 14, 15 and the phase contrast compensating plate 16, and optical arrangement of 17 so that the Ming display of the transparency display 10 might be good. Namely, in this example of comparison, in the liquid crystal display shown in an example 7, optical arrangement of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 is set up so that the Ming display of the transparency display 10 may be good. And liquid crystal carries out orientation to the liquid crystal layer 1 to a substrate 4-5 at parallel (parallel to the screen). And the liquid crystal layer which carried out twist orientation 70 degrees was used, and the liquid crystal display shown in an example 7 and the liquid crystal display designed similarly were produced except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display.
[0315] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained in this example of comparison, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 4 using the criteria of a common direction.
[0316] [Example 9] In the liquid crystal display shown in an example 8 by this example While the phase contrast compensating plate 16 is constituted from a phase contrast compensating plate of two sheets, the phase contrast compensating plate 17 is constituted from a phase contrast compensating plate of one sheet. Liquid crystal carries out orientation to the liquid crystal layer 1 to a substrate 4-5 at parallel (parallel to the screen). And the liquid crystal layer which carried out twist orientation 70 degrees was used, and the liquid crystal display shown in an example 8 and the liquid crystal display designed similarly were produced except having used the polarization conversion operation of the liquid crystal layer 1 by the twist orientation of this liquid crystal layer 1 for the display.
[0317] As the insulator layer 11 which consists of a sensitization resin which has insulation is not more specifically formed on a substrate 5 in an example 1 by this example and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that voltage might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the liquid crystal cell outside By the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal pouring which both has 7.5-micrometer liquid crystal thickness (d).
[0318] Moreover, the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell. In addition, the phase contrast compensating plate 17 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 16 from this example. The pasting direction of these phase contrast compensating plate 16-17 and a polarizing plate 14-15 was determined corresponding to the direction of orientation of liquid crystal (orientation direction).
[0319] And in this example, the liquid crystal display was produced so that the twist orientation (twist angle of the orientation of liquid crystal (twist angle)) of the liquid crystal layer 1 might become 70 degrees. Specifically, orientation processing was performed using the orientation film of an parallel stacking tendency by performing rubbing

processing so that the rubbing crossed axes angle may become 250 degrees so that the liquid crystal orientation when not impressing voltage to the orientation film 2-3 might turn into parallel orientation. In addition, a rubbing crossed axes angle shall follow the above-mentioned definition. And between the electrode substrates in the liquid crystal cell for the above-mentioned liquid crystal pouring, when the refractive-index difference (deltan) of a liquid crystal constituent introduced the liquid crystal constituent which has the positive dielectric constant anisotropy of 0.065 by the vacuum pouring-in method, the liquid crystal layer 1 was formed. By operation of the chiral additive added to such orientation processing and the liquid crystal constituent, as mentioned above, the twist angle (twist angle) of the orientation of liquid crystal can be made into 70 degrees. In addition, the above-mentioned chiral additive is adjusting the addition so that the above-mentioned twist angle may be acquired. Thus, according to voltage, orientation change produces the liquid crystal layer 1 which carried out orientation with impression of voltage from the liquid crystal of the direction center section of thickness of the liquid crystal layer 1.

[0320] Moreover, in this example, the refractive-index difference (deltan) of the liquid crystal constituent suitable for the transparency display and the product (deltan-d) of liquid crystal thickness (d) were used for the reflective display 9. Here, although the transparency display 10 is set up like the transparency display 10 of the example 5 in the form 2 of the aforementioned implementation, the liquid crystal thickness is equal to the transparency display 10, and it is set up by the reflective display 9, and differ in the example 5. For this reason, in this example, in an example 5, again, the optical design was performed and optical arrangement of a polarizing plate 14-15 and optical arrangement of the phase contrast compensating plate 16-17 are determined. In this example, optical arrangement of these polarizing plates 14-15 and the phase contrast compensating plate 16-17 was set up so that a reflective display might be good.

[0321] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the liquid crystal display obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 4 using the criteria of a common direction.

[0322] In addition, the optical arrangement shown in Table 4 is each optical element arrangement by the screen in case an observer observes the screen, and when the phase contrast compensating plate 16 or the phase contrast compensating plate 17 is constituted by two or more phase contrast compensating plates, each phase contrast compensating plate which constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side. Moreover, each direction in Table 4 expresses with the unit of a degree the direction from the criteria direction arbitrarily taken on the screen, and the retardation of each phase contrast compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.

[0323]

[Table 4]

			比較例４	比較例５	実施例９
偏光板１４		透過軸方位　（度）	０	０	０
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１８	１８	１８
		リタデーション（ｎｍ）	２７０	２７０	１２７
	位相差補償板	遅相軸方位　（度）	１２６	１２６	１２６
		リタデーション（ｎｍ）	１３５	１３５	１３５
液晶層１		基板４配向方位　（度）	１６	１６	１６
		基板５配向方位　（度）	８６	８６	８６
位相差補償板１７	位相差補償板	遅相軸方位　（度）	３６	３６	－４
		リタデーション（ｎｍ）	１３５	１３５	２６０
	位相差補償板	遅相軸方位　（度）	９６	１０８	なし
		リタデーション（ｎｍ）	２７０	２７０	なし
偏光板１５		透過軸方位　（度）	２１	０	１５２

[0324] As mentioned above, in the liquid crystal display concerning the example 7 and the examples 3-5 of comparison which have 4.5-micrometer liquid crystal thickness (d), liquid crystal thickness is set up so that it may be suitable for a reflective display. For this reason, in the above-mentioned example 7 and the examples 3-5 of comparison, optical arrangement with the polarizing plate 14 and the phase contrast compensating plate 16 only related to the reflective display is set up so that it may be suitable for a reflective display. On the other hand, the transparency display 10 is set as the liquid crystal thickness in which the liquid crystal thickness differs from the liquid crystal thickness of the transparency display 10 of the liquid crystal display in each example of the gestalt 2 of the aforementioned implementation. For this reason, in the above-mentioned example 7 and the examples 3-5 of comparison, it combined with the optical property of the transparency display 10 of each liquid crystal display, and optical arrangement of the phase contrast compensating plate 17 and a polarizing plate 15 was set up. That is, in the example 7 and the example 4 of comparison, the liquid crystal display which can realize a good dark display was produced, and the liquid crystal display which can realize the good Ming display was produced in the example 3 of comparison, and the example 5 of comparison.
[0325] On the other hand, in the liquid crystal display concerning the example 8 and example 9 which have 7.5-micrometer liquid crystal thickness (d), liquid crystal thickness is set up so that it may be suitable for a transparency display. For this reason, in the above-mentioned example 8 and the example 9, optical arrangement of the polarizing plate 14 related to the transparency display, the phase contrast compensating plate 16, the phase contrast compensating plate 17, and a polarizing plate 15 is set up so that it may be suitable for a transparency display. Therefore, a display property is determined by optical arrangement of the polarizing plate 14 with which the reflective display 9 was set up to compensate for the transparency display, and the phase contrast compensating plate 16 in the above-mentioned example 8 and the example 9.
[0326] Moreover, the display property of each liquid crystal display obtained in the above-mentioned example 7, the example 3 of comparison, the example 8, the example 4 of comparison, the example 5 of comparison, and the example 9 is respectively shown in drawing 11 , drawing 12 , drawing 13 , drawing 14 , and drawing 15 . In addition, each measures these display properties using a microscope like an example 1, a horizontal axis shows the actual value of applied voltage in each above-mentioned drawing, and a vertical axis shows lightness (a reflection factor or permeability). Moreover, the permeability of the transparency display 10 on which neither of polarizing plate 14-15 is

stuck is made into 100% of permeability, and let the reflection factor of the reflective display 9 before sticking a polarizing plate 14 be 100% of reflection factors.

[0327] In drawing 11 , a curve 261 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 7, and a curve 262 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 7.

[0328] In the example 7, as shown in drawing 11 , while permeability rises with the rise of applied voltage, a reflection factor rises with the rise of applied voltage in the section whose applied voltage is 1V-2V, and it is decreasing with the rise of applied voltage in the section whose applied voltage is 1V-3V after it. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 40% and the transparency display 10 is 18% and the applied voltage of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 3% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V is 3V was 33% 28%.

[0329] Moreover, in drawing 12 , a curve 271 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3 of comparison, and a curve 272 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 3 of comparison.

[0330] As shown in drawing 12 , in the example 3 of comparison, both a reflection factor and permeability are rising with elevation of applied voltage in the section whose applied voltage is 1V-2V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 18% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1V is 2V was 40% 40%.

[0331] In drawing 13 , a curve 281 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 8, and a curve 282 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 8.

[0332] As shown in drawing 13 , in the section whose applied voltage is 1V-2V in the example 8 While permeability rises with the rise of applied voltage, a reflection factor After going up with the rise of applied voltage in the section whose applied voltage is 0.7V-1.2V, applied voltage once decreases with the rise of applied voltage in the section which are 1.2V-1.7V, and it is going up with the rise of applied voltage again after that in the section whose applied voltage is 1.7V-2.3V. Moreover, the reflection factor of the reflective display 9 in case 40% and the applied voltage of the reflection factor of the reflective display 9 in case as for the permeability of 24% and the transparency display 10 the reflection factor of the reflective display 9 in case applied voltage is 1V is 3% and its applied voltage is 1.2V are 1.7V was 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 2V was 39% 27%.

[0333] In drawing 14 , a curve 291 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4 of comparison, and a curve 292 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 4 of comparison.

[0334] As shown in drawing 14 , in the example 4 of comparison, both a reflection factor and permeability are rising with elevation of applied voltage in the section whose applied voltage is 1.2V-3V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 1% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1.2V is 3V was 16% 36%.

[0335] In drawing 15 , a curve 311 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5 of comparison, and a curve 312 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 5 of comparison.

[0336] As shown in drawing 15 , in the example 5 of comparison, both a reflection factor and permeability are rising with elevation of applied voltage in the section whose applied voltage is 1.2V-3V. Moreover, the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case the permeability of 3% and the transparency display 10 is 21% and the applied voltage of the reflection factor of the reflective display 9 in case

applied voltage is 1.2V is 3V was 35% 39%.
[0337] In drawing 16 , a curve 321 shows the voltage dependency of the reflection factor of the reflective display 9 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 9, and a curve 322 shows the voltage dependency of the permeability of the transparency display 10 to the voltage between the electrodes 6 and electrodes 7 in the liquid crystal display obtained in the example 9.
[0338] In the example 9, as shown in drawing 16 , while permeability rises with the rise of applied voltage, a reflection factor once decreases with the rise of applied voltage in the section whose applied voltage is 0.9V-1.7V, and is rising with the rise of applied voltage after it in the section whose applied voltage is 1.2V-3V. Moreover, the reflection factor of the reflective display 9 in case the permeability of 7% and the transparency display 10 is 32% and the applied voltage of the reflection factor of the reflective display 9 in case applied voltage is 1.2V is 1.7V was 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 3V was 36% 37%.
[0339] In the liquid crystal display which uses change of the polarization state by polarization conversion operation of the retardation of the liquid crystal layer 1, the rotatory polarization, etc. for a display using a polarizing plate 14-15 so that clearly from the above example and example of comparison When the liquid crystal thickness of the liquid crystal layer 1 is made in agreement by the reflective display 9 and the transparency display 10, When the same voltage is impressed to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10, (when the reflective display 9 and the transparency display 10 are driven on common voltage) As shown in an example 7 and the examples 3-5 of comparison, at the time of impression of voltage fully compatible by the reflective display 9 in the lightness and the contrast ratio of the Ming display, coexistence with the lightness of the Ming display of the transparency display 10 and a contrast ratio is not enough. As shown in an example 8 and an example 9, at the time of impression of voltage fully compatible by the transparency display 10 in the lightness and the contrast ratio of the Ming display, change of the lightness of the reflective display 9 and change of the lightness of the transparency display 10 are not in agreement, and it does not become a good display.
[0340] However, each liquid crystal display obtained in the example 7, the example 8, and the example 9 is what (the reflective display 9 and the transparency display 10 are driven on different voltage) different voltage to the electrode 7 in the reflective display 9 and the electrode 7 in the transparency display 10 is impressed for, and can be considered as a good display.
[0341] That is, each liquid crystal display of the above-mentioned example 7 - an example 9 By impressing the voltage from which all differ to the electrode 7 in the reflective display 9, and the electrode 7 in the transparency display 10 While it is [as opposed to / the transparency display 10 / both] compatible in the lightness and the contrast ratio of the Ming display also to the reflective display 9, the light and darkness of a display can be made in agreement by the reflective display 9 and the transparency display 10, and it turns out that the display excellent in visibility is realizable.
[0342] In the liquid crystal display which uses a polarization conversion operation of the retardation of the liquid crystal layer 1, the rotatory polarization, etc. for a display using a polarizing plate 14-15 as a result of comparing the form of this operation with the form 2 of the aforementioned implementation In order to reconcile the lightness and the contrast ratio of the Ming display by both the reflective display 9 and the transparency display 10, it turns out that it is effective to set up more greatly than the thickness of the liquid crystal layer 1 in the reflective display 9 the thickness of the liquid crystal layer 1 in the transparency display 10.
[0343] In addition, although the liquid crystal orientation in the state where voltage is not impressed showed the parallel thing to the direction of a flat surface of the screen as liquid crystal display mode in each example in the form of this operation, and the form 2 of the aforementioned implementation It cannot be overemphasized by using the liquid crystal material of a different property from the liquid crystal material illustrated in each above-mentioned example, or using the orientation film of a different property from the illustrated orientation film that perpendicular orientation mode, hybrid orientation mode, etc. can be used.
[0344] Furthermore, even if liquid crystal display mode is which the mode in which the retardation or rotatory polarization of the liquid crystal layer 1 was used, liquid crystal thickness influences an optical property and all the things for which the one where the liquid crystal thickness in the reflective display 9 is thinner than the liquid crystal thickness in the transparency display 10 is suitable cannot be overemphasized by that a good optical property is realized by this invention.
[0345] Moreover, an example 4 and an example 7 - an example 9 are giving the voltage in which the reflective display 9 and the transparency display 10 change with electrodes 6-7 (orientation mechanism), and understand a bird clapper as displaying good being possible. In this case, it becomes possible in an example 4 and the example 7 to indicate the transparency display 10 good by fully impressing voltage to the transparency display 10. Moreover, a good display is attained when an example 8 and an example 9 all adjust the voltage of the reflective display 9. Therefore, according to

the form of this operation, and the form 2 of the aforementioned implementation, it turns out that a good display is realizable by producing a liquid crystal cell beforehand so that voltage can be changed by the reflective display 9 and the transparency display 10 besides the method of changing liquid crystal thickness by the reflective display 9 and the transparency display 10.

[0346] [Gestalt 4 of operation] With the gestalt of this operation, by changing the orientation processing direction on the substrate which determines liquid crystal orientation (rubbing direction), i.e., the orientation processing direction of an orientation film established in each electrode substrate, by the reflective display and the transparency display, and changing liquid crystal orientation by the reflective display and the transparency display explains the liquid crystal display which realizes a good reflective display and a good transparency display.

[0347] With the gestalt of this operation, in order to carry out orientation of the liquid crystal layer uniformly, the so-called rubbing method is used. In order to change the orientation processing direction of an orientation film established in each electrode substrate by the reflective display and the transparency display with the gestalt of this operation, it is possible to realize at least two kinds of liquid crystal orientation by wearing an orientation film front face by the photoresist etc. on the occasion of rubbing processing of an orientation film. According to this method, it becomes possible to be able to realize simultaneously liquid crystal orientation suitable for the reflective display, and liquid crystal orientation suitable for the transparency display, consequently to realize a good reflective display and a good transparency display.

[0348] Although the liquid crystal display concerning the form of this operation is hereafter explained more to a detail, the same number is given to the component which has the function as the form 3 of the form 1 of the aforementioned implementation - operation of explanation same for convenience, and the explanation is omitted.

[0349] First, orientation down stream processing of the substrate (electrode substrate 40) used for the liquid crystal display concerning the form of this operation is explained using drawing 17 and drawing 18 (a) - (e).

[0350] First, as shown in drawing 18 (a), orientation film material is applied to the contact surface with the liquid crystal layer 1 in the substrate 41 (equivalent to the substrate 4 after electrode 6 formation, or the substrate 5 after electrode 7 formation) which constitutes a liquid crystal cell (S1). Prebaking (S2) and curing (S3) are performed, and the orientation film 42 (equivalent to the orientation film 2 or the orientation film 3) is formed in the contact surface with the liquid crystal layer 1 in the above-mentioned substrate 41.

[0351] Subsequently, orientation processing of the electrode substrate 40 which equipped the interface with the liquid crystal layer 1 on the above-mentioned substrate 41 with the orientation film 42 is performed by carrying out rubbing processing of the above-mentioned orientation film 42. Under the present circumstances, with the form of this operation, first, as shown in drawing 18 (b), the screen by the resist 43 for rubbing processing screens is performed so that rubbing processing may be performed partially. In this case, so that the resist material for rubbing processing screens may be applied (S4) and some above-mentioned orientation films 42 (1st orientation processing field 42a) may be first exposed after prebaking (S5) on the above-mentioned orientation film 42 UV mask exposure (S6), development (S7), and curing (S8) are performed, and rubbing processing is performed to orientation processing field 42a of the above 1st after that (S9). Subsequently, after washing the electrode substrate 40 after this rubbing processing (S10), as shown in drawing 18 (c), the above-mentioned resist 43 is exfoliated (S11).

[0352] Then, in order to realize different liquid crystal orientation from the liquid crystal orientation in orientation processing field 42a of the above 1st, as shown in drawing 18 (d), the portion (1st orientation processing field 42a) by which rubbing was already carried out is protected by the resist 44 for rubbing processing screens, and rubbing processing of an unsettled portion is performed. That is, the resist material for rubbing processing screens is applied on the orientation film 42 which exfoliated the resist 43 (S12). So that orientation processing fields other than 1st orientation processing field 42a on the above-mentioned orientation film 42 (2nd orientation processing field 42b) may be exposed after prebaking (S13) UV mask exposure (S14), development (S15), and curing (S16) are performed, and after that, with orientation processing field 42a of the above 1st, rubbing processing is performed to orientation processing field 42b of the above 2nd so that a processing direction may become separate (S17). Subsequently, after washing the electrode substrate 40 after this rubbing processing (S18), as shown in drawing 18 (e), the above-mentioned resist 44 is exfoliated (S19). Thereby, the orientation film 42 (orientation mechanism) by which orientation processing was carried out was obtained in two kinds of the different directions.

[0353] Thus, with the gestalt of this operation, orientation processing patterning was carried out [processing] by the resist is performed twice or more. At this time, it is possible to realize at least two kinds of liquid crystal orientation (for example, two or more kinds of parallel orientation from which the direction of orientation differs) what (orientation processing of two directions is performed by two orientation processings in the above-mentioned explanation) a processing direction is changed for for every orientation processing. And in this way, by changing an orientation processing direction by one [at least] substrate (electrode substrate), the orientation of the reflective

display 9 and the transparency display 10 can be set up independently, and a good display is attained.
[0354] Next, while realizing liquid crystal orientation which changes by the reflective display 9 and the transparency display 10 with methods mentioned above, the liquid crystal display which used the polarizing plate 14-15 is explained below using a concrete example. However, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0355] [Example 10] In this example, the liquid crystal display was produced according to the manufacture method of the liquid crystal display shown in the aforementioned example 5 of comparison. As the insulator layer 11 which consists of a sensitization resin which has insulation is not specifically formed on a substrate 5 in an example 1 and it is shown in drawing 4 The electrode 7 of the reflective display 9 and the electrode 7 of the transparency display 10 are insulated electrically. Except having produced the electrode pattern so that voltage might be separately impressed to the electrode 7 of the reflective display 9, and the electrode 7 of the transparency display 10 from the outside By the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method, the reflective display 9 and the transparency display 10 produced the liquid crystal cell for liquid crystal pouring which both has 4.5-micrometer liquid crystal thickness (d) and the (cell gap). And the phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in this liquid crystal cell. The above-mentioned phase contrast compensating plate 16 and the phase contrast compensating plate 17 consisted of phase contrast compensating plates of every two sheets respectively.
[0356] However, in this example, orientation division was performed on the occasion of rubbing processing of the orientation film 3 by the method shown in drawing 17 and drawing 18 (a) - drawing 18 (e), and the same method. That is, in this example, to the orientation film 2 by the side of a substrate 4, rubbing was performed in the same direction by the reflective display 9 and the transparency display 10, and to the orientation film 3 (orientation mechanism) by the side of a substrate 5, rubbing was performed in the direction which is different by the reflective display 9 and the transparency display 10 so that liquid crystal orientation directions might differ by the reflective display 9 and the transparency display 10.
[0357] Moreover, in this example, the liquid crystal display mode using the liquid crystal orientation which is parallel (parallel to a substrate 4-5), and was twisted was used for the screen, and the display mode using the liquid crystal orientation which is parallel (parallel to a substrate 4-5), and is not twisted to the screen was used for the transparency display 10 at the reflective display 9.
[0358] Moreover, in this example, about 270nm and the twist angle (twist angle) of the orientation of liquid crystal are 70 degrees, and deltan-d of the liquid crystal layer 1 in the reflective display 9 produced the liquid crystal display about 270nm and whose twist angle (twist angle) of the orientation of liquid crystal deltan-d of the liquid crystal layer 1 in the transparency display 10 is 0 times. Consequently, the liquid crystal display which can perform a good display by both the reflective display 9 and the transparency display 10 was obtained, without having the liquid crystal layer 1 which was open for free passage by the reflective display 9 and the transparency display 10, and changing a cell gap.
[0359] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the reflective display 9 and the transparency display 10 of a liquid crystal display which were obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 5 using the criteria of a common direction.
[0360] In addition, each phase contrast compensating plate which the optical arrangement shown in Table 5 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side. Moreover, each direction in Table 5 expresses with the unit of a degree the direction from the criteria direction arbitrarily taken on the screen, and the retardation of each phase contrast compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0361]
[Table 5]

			実施例１０	
			反射表示部９	透過表示部１０
偏光板１４		透過軸方位　（度）	０	
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１５	
		リタデーション（ｎｍ）	２７０	
	位相差補償板	遅相軸方位　（度）	７５	
		リタデーション（ｎｍ）	１３５	
液晶層１		基板４配向方位　（度）	－１５	－１５
		基板５配向方位　（度）	５５	－１５
位相差補償板１７	位相差補償板	遅相軸方位　（度）	－１５	
		リタデーション（ｎｍ）	１１５	
	位相差補償板	遅相軸方位　（度）	－７５	
		リタデーション（ｎｍ）	２７０	
偏光板１５		透過軸方位　（度）	９０	

[0362] Next, operation of each optical element in the gestalt of this operation is explained below. First, the case where voltage is not impressed to the liquid crystal layer 1 is explained. In this case, according to the orientation processing direction of the orientation film 2-3 established, the orientation, i.e., each electrode substrate, of the substrate interface which touches this liquid crystal layer 1, orientation of the liquid crystal in the above-mentioned liquid crystal layer 1 is carried out. For example, with the liquid crystal display obtained in the above-mentioned example 10, when not mixing a chiral additive in a liquid crystal constituent, twist orientation is carried out to 70 left, and it is in the 0 times twist orientation state which is not twisted by the transparency display 10 at the reflective display 9.
[0363] For this reason, by the reflective display 9, when voltage is not impressed to the liquid crystal layer 1, if deltan-d of the liquid crystal layer 1 is set as about 270nm, if the circular polarization of light carries out incidence of this liquid crystal layer 1, it will act so that the linearly polarized light may be made to change and penetrate it. By the liquid crystal layer 1, it is changed into the circular polarization of light by the phase contrast compensating plate 16, and the light which carries out incidence to the liquid crystal layer 1 from a polarizing plate 14 side is further changed into the linearly polarized light from the circular polarization of light, it reaches the reflective film 8 and is reflected. When voltage is not impressed to the liquid crystal layer 1 in the above-mentioned liquid crystal display from being again changed into the transparency component of a polarizing plate 14 when the light reflected by the reflective film 8 is the linearly polarized light on the reflective film 8, the display of the reflective display 9 will be the Ming display.
[0364] Moreover, by the transparency display 10, when voltage is not impressed to the liquid crystal layer 1, if deltan-d of the liquid crystal layer 1 is set as 250nm - about 270nm, the liquid crystal layer 1 will act as 1/2 wavelength plate. That is, when the circular polarization of light by which incidence was carried out to the liquid crystal layer 1 turns into the circular polarization of light which intersects perpendicularly with the incidence **** circular polarization of light, for example, incidence of the right-handed circularly polarized light (right-handed-rotation circular polarization of light) is carried out, this right-handed circularly polarized light is changed into the left-handed circularly-polarized light (left-handed-rotation circular polarization of light), and when incidence of the left-handed circularly-polarized light is carried out, this circular polarization of light is changed into the right-handed circularly polarized light. The light which carried out incidence to the transparency display 10 passes a polarizing plate 15, it is changed into the

circular polarization of light, and incidence is carried out to the liquid crystal layer 1 by the phase contrast compensating plate 17. In the above-mentioned example 10, the polarization state is the counterclockwise circular polarization of light mostly, this circular polarization of light carries out incidence of the circular polarization of light by which incidence is carried out to the liquid crystal layer 1 from the above-mentioned phase contrast compensating plate 17 to the liquid crystal layer 1, and it is changed into the clockwise circular polarization of light. And in the phase contrast compensating plate 16, since the right-handed-rotation circular polarization of light is changed into the linearly polarized light of the transparency shaft orientations of a polarizing plate 14 and the left-handed-rotation circular polarization of light is changed into the linearly polarized light of absorption shaft orientations, when voltage is not impressed to the liquid crystal layer 1 in the above-mentioned liquid crystal display, the display of the transparency display 10 will be the Ming display.

[0365] Next, the case where voltage is impressed to the liquid crystal layer 1 is explained. If voltage is impressed to the liquid crystal layer 1, irrespective of whether the liquid crystal in this liquid crystal layer 1 is the reflective display 9, or it is the transparency display 10, according to voltage, orientation will be carried out at right angles to a substrate 4-5, and the above-mentioned polarization conversion operation will become weaker in connection with it. That is, in order that the circular polarization of light prepared by the phase contrast compensating plate 16-17 may pass the liquid crystal layer 1 as it is, also in the reflective display 9, a dark display is realized also in the transparency display 10.

[0366] In addition, in the above-mentioned example 10, the phase contrast compensating plate of a 115nm retardation is used for the phase contrast compensating plate 17. In order to accept it phase contrast compensating plate 17, to come out and to realize the good circular polarization of light, although it is desirable that it is about 135nm as for the retardation of this phase contrast compensating plate 17, in order that the retardation may not disappear completely in voltage with the practical liquid crystal layer 1 of the transparency display 10, the retardation of the above-mentioned phase contrast compensating plate 17 is set up so that good contrast may be acquired in consideration of this.

[0367] Moreover, the phase contrast compensating plate 16 has the operation which changes into the circular polarization of light of large wavelength the polarization state of the light which carries out incidence to the liquid crystal layer 1 of the reflective display 9. And in the above-mentioned liquid crystal display, twist orientation of the liquid crystal layer 1 in the reflective display 9 is carried out 70 degrees, and the deltan-d is set as 270nm. For this reason, in the reflective display 9 in the above-mentioned liquid crystal display, the light which carries out incidence to the liquid crystal layer 1 is the circular polarization of light, and this circular polarization of light is changed into the linearly polarized light in the liquid crystal layer 1, passes the liquid crystal layer 1, and reaches to the reflective film 8. And the light which turned into the linearly polarized light on the reflective film 8 is reflected by the mirror plane of the reflective film 8, and even it passes each optical element by the reverse order, and becomes the linearly polarized light which finally has the oscillating electric field of the transparency shaft direction of a polarizing plate 14. For this reason, in the above-mentioned reflective display 9, it becomes the Ming display.

[0368] Moreover, the chiral agent which produces a left twist peculiar to the orientation of liquid crystal is mixed in the used liquid crystal constituent. This chiral agent changes a helical pitch peculiar to the liquid crystal constituent with which this chiral agent was mixed with the addition. For this reason, this helical pitch is adjusted and it becomes possible to make the voltage dependency of lightness in agreement by the reflective display 9 and the transparency display 10 using the minimum voltage from which liquid crystal orientation begins to change with helical pitches changing.

[0369] Thus, the display property of a liquid crystal display given in the produced example 10 is shown in drawing 19 . In addition, the display property shown in drawing 19 is measured by the same method as an example 1, a horizontal axis shows the actual value of applied voltage, and a vertical axis shows lightness (a reflection factor or permeability).

[0370] In drawing 19 , a curve 331 shows the voltage dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 10, and a curve 332 shows the voltage dependency of the permeability of the transparency display 10 in the liquid crystal display obtained in the example 10.

[0371] drawing 19 -- from -- understanding -- as -- an example -- ten -- obtaining -- having had -- the above -- a liquid crystal display -- voltage -- not impressing -- the time -- **** -- Ming -- a display -- carrying out -- coming -- **** -- this -- a liquid crystal display -- **** -- voltage -- impression -- following -- a reflection factor -- and -- permeability -- decreasing -- being the so-called -- a normally white -- (-- NW --) -- the mode -- depending -- a display -- having realized . Moreover, the above-mentioned liquid crystal display can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while being able to set up a contrast ratio almost to the same extent by the reflective display 9 and the transparency display 10, and it can realize the display excellent in visibility.

[0372] As mentioned above, both the things set up as a concrete means for changing liquid crystal orientation by the reflective display 9 and the transparency display 10 so that the twist angles of the liquid crystal layer 1 may differ by

the reflective display 9 and the transparency display 10 are effective in order to realize a good display by the reflective display 9 and the transparency display 10.
[0373] In addition, although rubbing processing of a direction which is different by the reflective display 9 and the transparency display 10 is performed and twist orientation of the liquid crystal layer 1 of the reflective display 9 is carried out in the above-mentioned example 10 in order to change the twist angle of the liquid crystal layer 1 by the reflective display 9 and the transparency display 10 Although the liquid crystal layer 1 of the transparency display 10 used the combination which has not carried out twist orientation, especially the means for changing the twist angle of the liquid crystal layer 1 by the reflective display 9 and the transparency display 10 is not limited.
[0374] For example, it is (1) in addition to the above-mentioned combination shown in an example 10. The combination from which the twist angle and sense of the twist differ although twist orientation of both the liquid crystal layer 1 in the reflective display 9 and the liquid crystal layer 1 in the transparency display 10 is carried out, (2) Although the liquid crystal layer 1 in the reflective display 9 is not twisted, the liquid crystal layer 1 in the transparency display 10 may use the combination currently twisted. (3) the inclinations (the so-called pre tilt) of liquid crystal to a substrate 4-5 differ by the reflective display 9 and the transparency display 10 -- you may combine and come out Moreover, (4) Change of the liquid crystal orientation in a substrate interface may be combined with other meanses of this invention, and it is (5). That from which a cell gap differs by the reflective display 9 and the transparency display 10, and (6) Electric fields may differ by the reflective display 9 and the transparency display 10.
[0375] [Form 5 of operation] Although each example in the forms 2-4 of the aforementioned implementation explained the composition for realizing a good reflective display and a good transparency display using the liquid crystal display in which liquid crystal is carrying out orientation in parallel to the substrate, with the form of this operation, the orientation direction of liquid crystal explains a perpendicular liquid crystal display to a substrate like the example 1 in the form 1 of the aforementioned implementation. However, with the form of this operation, the design for performing the display which used the birefringence or optical activity (polarization conversion operation) of liquid crystal using the polarizing plate was performed, without mixing dichroism coloring matter in a liquid crystal layer. In addition, the same number is given to the component which has the function as the form 4 of the form 1 of the following and aforementioned implementation - operation of explanation same for convenience, and the explanation is omitted.
[0376] In the liquid crystal display concerning the form of this operation, a dielectric constant anisotropy uses negative liquid crystal for the liquid crystal layer 1. Moreover, the perpendicular orientation film which carries out orientation of the liquid crystal to the orientation film 2-3 which pinches the liquid crystal layer 1 perpendicularly is used. In this case, although orientation of the liquid crystal molecule is mostly carried out to the perpendicular to the substrate 4-5 (screen) while not impressing voltage to the liquid crystal layer 1, with impression of voltage, it inclines from [of a substrate 4-5] a normal, and orientation of it is carried out and it produces a polarization conversion operation to the light which passes in the direction of a normal of the layer of the stratified liquid crystal layer 1.
[0377] In the liquid crystal display concerning the form of this operation, even if the difference between the liquid crystal display using the orientation film 2-3 in which liquid crystal carries out orientation in parallel with a substrate, and the liquid crystal display concerning the form of this operation does not impress voltage, it is that liquid crystal carries out orientation in the direction of a normal of a substrate 4-5 to the layer of an interface with the electrode substrate in the liquid crystal layer 1. Then, with the form of this operation, in order to use this effectively, in not impressing voltage to a display, it uses NB (normally black) mode which becomes a black display. Specifically by the reflective display 9, it displays on the liquid crystal layer 1 by carrying out incidence of the circular polarization of light. moreover, from the phase contrast compensating plate 16 used also for a reflective display acting on polarization of the outgoing radiation light from the liquid crystal layer 1 in the transparency display 10 The above-mentioned liquid crystal layer 1 is driven by the electrode pair which connects the reflective display 9 and the transparency display 10 electrically, and in order to realize a dark display simultaneously, in consideration of the liquid crystal layer 1 carrying out orientation at right angles to a substrate 4-5 also in a transparency display, incidence of the circular polarization of light is carried out to the liquid crystal layer 1. For this reason, in the combination of a polarizing plate 14-15 and the phase contrast compensating plate 16-17, the retardation of the phase contrast compensating plate arranged by the liquid crystal layer 1 at the near side among two or more phase contrast compensating plates which constitute the phase contrast compensating plate 17 is set as 135nm. Thereby, with the form of this operation, good NB display is realizable.
[0378] Next, in the combination of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 mentioned above, a setup of the liquid crystal layer 1 which gives the good Ming display is explained.
[0379] With the form of this operation, as mentioned above, from [of a substrate 4-5] a normal, it inclines and orientation of the liquid crystal layer 1 is carried out with impression of voltage. It is desirable to act so that the circular polarization of light may be changed into the linearly polarized light, and to act to the transparency display 10 to the

reflective display 9, as this liquid crystal layer 1, so that the circular polarization of light may be changed into the circular polarization of light of the circumference of reverse where voltage is fully impressed to this liquid crystal layer 1. When the above-mentioned liquid crystal layer 1 does the above-mentioned conversion operation so, the good Ming display can be realized.
[0380] In order for the above-mentioned liquid crystal layer 1 to do the above-mentioned conversion operation so, it is desirable to carry out orientation processing of the orientation film 2-3 so that liquid crystal may not be made to produce the twist, and not to use a chiral additive for a liquid crystal constituent. That is, it is desirable to set up the liquid crystal layer 1 so that it may change lambda/4 in the reflective display 9 and may change with impression of the voltage to this liquid crystal layer 1 lambda/2 by the transparency display 10, when the retardation of the liquid crystal layer 1 sets wavelength of an incident light to lambda.
[0381] When being set up so that the thickness of the liquid crystal layer 1 in the reflective display 9 may differ from the thickness of the liquid crystal layer 1 in the transparency display 10, it is easy to set up for the liquid crystal layer 1 to do the above-mentioned conversion operation so, as the liquid crystal layer 1 was mentioned above.
[0382] Although a concrete example is hereafter given and explained about the liquid crystal display concerning the gestalt of this operation, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples.
[0383] [Example 11] In this example, the liquid crystal cell for liquid crystal pouring from which liquid crystal thickness differs by the reflective display 9 and the transparency display 10 was produced by the production method of the liquid crystal cell for liquid crystal pouring of an example 1, and the same method, and the perpendicular orientation film which has the operation which carries out orientation of the liquid crystal to the orientation film 2 and 3 perpendicularly to a substrate 4 and 5 was used. Orientation processing was performed so that liquid crystal might incline on the above-mentioned orientation film 2-3 a little and might carry out orientation to it from the normal direction (perpendicular direction) of a substrate 4-5 by rubbing.
[0384] In this example, the liquid crystal thickness (d) in the reflective display 9 However, 3 micrometers, While liquid crystal thickness (d) in the transparency display 10 is set to 6 micrometers and a refractive-index difference (deltan) forms the liquid crystal layer 1 in liquid crystal material using the liquid crystal which has the negative dielectric constant anisotropy of 0.06 The phase contrast compensating plate 16-17 and the polarizing plate 14-15 were stuck on the outside of each electrode substrate in the above-mentioned liquid crystal cell, and the liquid crystal display was produced. The above-mentioned phase contrast compensating plate 16 and the phase contrast compensating plate 17 consisted of phase contrast compensating plates of every two sheets respectively.
[0385] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the reflective display 9 and the transparency display 10 of a liquid crystal display which were obtained by this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 6 using the criteria of a common direction.
[0386] In addition, each phase contrast compensating plate which the optical arrangement shown in Table 6 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 16-17 is indicated in order of the actual arrangement from an observer side. Moreover, each direction in Table 6 expresses with the unit of a degree the direction from the criteria direction arbitrarily taken on the screen, and the retardation of each phase contrast compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.
[0387]
[Table 6]

			実施例１１	
			反射表示部９	透過表示部１０
偏光板１４		透過軸方位　（度）	０	
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１５	
		リタデーション（ｎｍ）	２７０	
	位相差補償板	遅相軸方位　（度）	７５	
		リタデーション（ｎｍ）	１３５	
液晶層１		基板４配向方位　（度）	－１５	－１５
		基板５配向方位　（度）	－１５	－１５
位相差補償板１７	位相差補償板	遅相軸方位　（度）	－１５	
		リタデーション（ｎｍ）	１３５	
	位相差補償板	遅相軸方位　（度）	－７５	
		リタデーション（ｎｍ）	２７０	
偏光板１５		透過軸方位　（度）	９０	

[0388] Thus, the display property of a liquid crystal display given in the produced this example is shown in drawing 20 . In addition, a display property given in drawing 20 is measured by the same method as an example 1, a horizontal axis shows the actual value of applied voltage, and a vertical axis shows lightness (a reflection factor or permeability).
[0389] In drawing 20 , a curve 341 shows the voltage dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 11, and a curve 342 shows the voltage dependency of the permeability of the transparency display 10 in the liquid crystal display obtained in the example 11.
[0390] When not impressing voltage, the above-mentioned liquid crystal display obtained in the example 11 performed the dark display, and the display by the so-called NB mode which a reflection factor and permeability increase with impression of voltage realized it with this liquid crystal display, so that drawing 20 might show. Moreover, the above-mentioned liquid crystal display can make the light and darkness of a display in agreement by the reflective display 9 and the transparency display 10 while being able to set up a contrast ratio almost to the same extent by the reflective display 9 and the transparency display 10, and it can realize the display excellent in visibility.
[0391] According to the gestalt of this operation, as mentioned above, by the reflective display 9 and the transparency display 10 In the liquid crystal display concerning this invention which realizes simultaneously different liquid crystal orientation By using at least for one side the orientation means (perpendicular orientation film) to which orientation of the liquid crystal is carried out at right angles to the substrate side which touches this liquid crystal (liquid crystal layer 1) among the reflective display 9 or the transparency display 10 It was checked that the transflective type liquid crystal display which can perform a good display by both the reflective display 9 and the transparency display 10 is realized.
[0392] [Gestalt 6 of operation] With the gestalt of this operation, when displaying by changing liquid crystal orientation on voltage, in either [at least] a reflective display or a transparency display, the liquid crystal display which displays by changing the orientation direction of liquid crystal is explained, maintaining the orientation state of liquid crystal in the parallel state to the screen (substrate). That is, in the liquid crystal display concerning the gestalt of this operation, a liquid crystal molecule rotates in parallel to the screen (substrate) in either [at least] a reflective display or a transparency display by impression of voltage.
[0393] Although the liquid crystal display concerning the gestalt of this operation is hereafter explained using a

concrete example, the liquid crystal display concerning the gestalt of this operation is not limited at all by the following examples. In addition, the same number is given to the component which has the function as the gestalt 5 of the gestalt 1 of the aforementioned implementation - operation of explanation same for convenience, and the explanation is omitted.
[0394] [Example 12] At this example, by using for transflective type liquid crystal the installation-performance-specification (in plane switching) mode used in order for a penetrated type liquid crystal display to realize a wide-field-of-view angle, a liquid crystal molecule is rotated in parallel to a substrate to a substrate by the horizontal electric field of field inboard, and the liquid crystal display which gave the optical-switch function is explained below with reference to drawing 21 (a) and drawing 21 (b).
[0395] In addition, although the installation-performance-specification mode itself was conventionally used in the field of a penetrated type liquid crystal display, on the Kushigata electrode used at the time of this installation-performance-specification mode use, the liquid crystal orientation on eye an inadequate hatchet and the above-mentioned Kushigata electrode was not able to be contributed to a transparency display at a display, and liquid crystal orientation change was not able to realize a good display. However, according to this example, by the conventional installation-performance-specification method, a reflective display can be realized in the field on the Kushigata wiring which has not been used, and the use efficiency of light can obtain a transflective type high liquid crystal display.
[0396] Drawing 21 (a) is an important section cross section at the time of no voltage impressing the liquid crystal display concerning this example, and drawing 21 (b) is an important section cross section at the time of voltage impression of the liquid crystal display shown in drawing 21 (a). In addition, drawing 21 (a) and drawing 21 (b) show a cross section when each cuts the liquid crystal cell in this liquid crystal display in respect of being perpendicular to the direction in which electrode wiring (terminal) of the Kushigata electrode in which it was prepared by this liquid crystal cell is prolonged.
[0397] The liquid crystal display shown in drawing 21 (a) and drawing 21 (b) the substrate 51 in which the liquid crystal layer 1 has a translucency, and the Kushigata electrode 53 (the contents rewriting means of a display --) which has light reflex nature While being pinched by the substrate 54 which possesses light reflex nature by having a voltage impression means and an orientation mechanism and equipping the outside (namely, the opposed face with a substrate 54 opposite side) of a substrate 51 with the phase contrast compensating plate 16 and a polarizing plate 14 further It has the composition which equipped the outside (namely, the opposed face with a substrate 51 opposite side) of a substrate 54 with the phase contrast compensating plate 17 and the polarizing plate 15. In addition, the phase contrast compensating plate 16 was constituted from a phase contrast compensating plate of one sheet, and the phase contrast compensating plate of two sheets constituted the phase contrast compensating plate 17 from this example.
[0398] In one [among the substrates of the couple in which, as for the above-mentioned liquid crystal display, this example was also prepared on both sides of the above-mentioned liquid crystal layer 1] substrate 54 (electrode substrate) On a glass substrate 52, the sensitization resin which has insulation is applied with a spin coat, and a sensitization resin does not remain in the transparency display 10 by mask irradiation of ultraviolet radiation further. in the reflective display 9 Pattern formation of the insulator layer 11 (orientation mechanism) is carried out so that this sensitization resin may be formed in predetermined thickness. Thereby, the thickness of the liquid crystal layer 1 in the transparency display 10 is set up more thinly than the thickness of the liquid crystal layer 1 in the reflective display 9.
[0399] Moreover, in the above-mentioned liquid crystal display concerning this example, on the above-mentioned glass substrate 52, the Kushigata electrode 53 (orientation mechanism) which has light reflex nature is formed so that the above-mentioned insulator layer 11 may be covered. This Kushigata electrode 53 is a reflective pixel electrode which serves both as the liquid crystal drive electrode which drives the liquid crystal layer 1, and a reflective film (reflective means), and is produced with the metal with the high reflection factor of light.
[0400] In the above-mentioned liquid crystal display, the orientation state of liquid crystal molecule 1a changes with the electric fields in which the seal of approval is carried out by the Kushigata electrode 53 by the transparency display 10. Moreover, in the reflective display 9, while the liquid crystal layer 1 drives by the electric field by the above-mentioned Kushigata electrode 53, the reflex action of the above-mentioned Kushigata electrode 53 is used for the display.
[0401] In addition, in this example, although wiring of the Kushigata electrode 53 is used for the reflective means, in order to give light-scattering nature to this Kushigata electrode 53, the film which has light-scattering nature may be further formed in the field which concavo-convex structure may be formed in the front face, and counters the Kushigata electrode 53 in the outside of a glass substrate 51.
[0402] In the liquid crystal display shown in drawing 21 (a) and drawing 21 (b), mutually different potential is given to Kushigata electrode 53aand53b which adjoins each other mutually, and electric field arise between the above-mentioned Kushigata electrode 53a and 53b. As shown in drawing 21 (b), the transparency display 10 is equivalent to

the gap section of Kushigata electrode 53a and 53b, and in this portion, liquid crystal orientation maintains the direction where the orientation direction is parallel to a glass substrate 52, and changes with above-mentioned Kushigata electrode pairs (Kushigata electrode 53aand53b) a lot. Moreover, the reflective display 9 is equivalent to right above [of the Kushigata electrode 53 (Kushigata electrode 53aand53b)], and liquid crystal orientation changes also to a perpendicular direction in this portion not only to change of a direction but to the glass substrate 52 in alignment with the flat surface of a glass substrate 52. This is because line of electric force has the component perpendicular to a glass substrate 52 by the reflective display 9 to line of electric force (a dashed line showing among drawing) being mostly prolonged in parallel to a glass substrate 52 in the transparency display 10, as shown in drawing 21 (b).

[0403] Optical arrangement (namely, the pasting direction of a polarizing plate 14-15 and the phase contrast compensating plate 16-17 and the orientation direction of liquid crystal) of the polarizing plate 14-15 in the reflective display 9 and the transparency display 10 of a liquid crystal display concerning this example, the phase contrast compensating plate 16-17, and the liquid crystal layer 1 is shown in Table 7 using the criteria of a common direction.

[0404] In addition, each phase contrast compensating plate which the optical arrangement shown in Table 7 is each optical element arrangement by the screen in case an observer observes the screen, and constitutes the above-mentioned phase contrast compensating plate 17 is indicated in order of the actual arrangement from an observer side.

[0405] Moreover, the orientation direction (orientation direction of the major axis of liquid crystal molecule 1a) of the liquid crystal layer 1 is equal to the rubbing processing direction in substrate 51 front face in a substrate 51 side, and equal to the rubbing processing direction in substrate 54 front face in a substrate 54 side. Hereafter, a substrate 51 orientation direction and the orientation direction of the liquid crystal layer 1 by the side of a substrate 54 are described for the orientation direction of the liquid crystal layer 1 by the side of a substrate 51 as a substrate 54 orientation direction.

[0406] Moreover, each direction in Table 7 expresses with the unit of a degree the direction from the criteria direction arbitrarily taken on the screen, and the retardation of each phase contrast compensating plate shows the value over the homogeneous light with a wavelength of 550nm per nm.

[0407] The direction where electrode wiring (terminal) of the Kushigata electrode 53 is prolonged here is a 65-degree direction, and it changed so that liquid crystal molecule 1a which liquid crystal orientation is with the transparency display 10 and the reflective display 9, and has turned to both directions 75 degrees with impression of voltage might have a bigger direction than a direction 75 degrees. Moreover, in the above-mentioned liquid crystal display, deltan-d of the liquid crystal layer [in / 130nm order and the transparency display 10 / in deltan-d of the liquid crystal layer 1 in the reflective display 9] 1 is set up before and after 240nm.

[0408]

[Table 7]

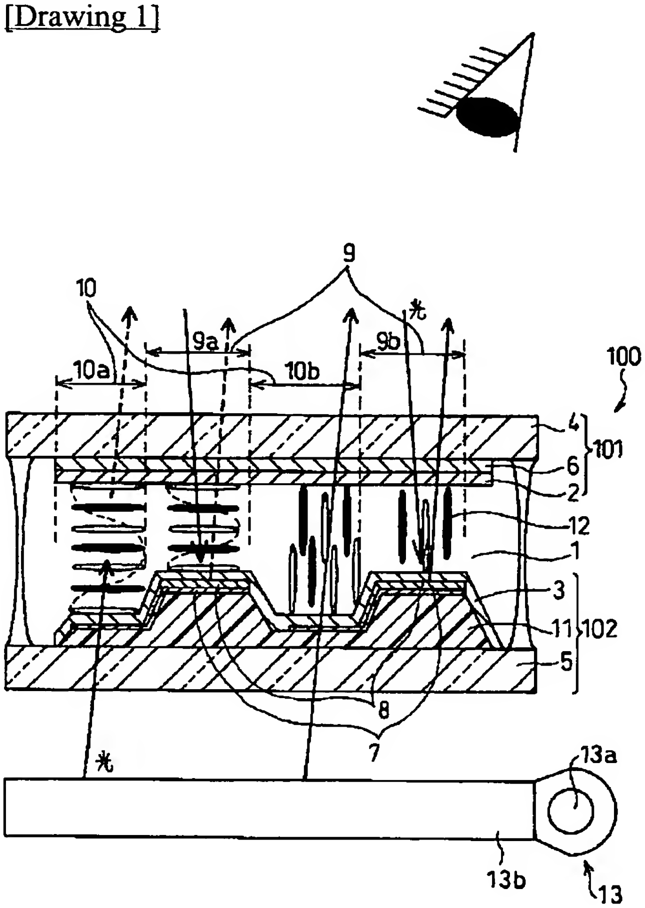
			実施例１２	
			反射表示部９	透過表示部１０
偏光板１４		透過軸方位　（度）	０	
位相差補償板１６	位相差補償板	遅相軸方位　（度）	１５	
		リタデーション（ｎｍ）	２７０	
液晶層１		基板５１配向方位（度）	７５	７５
		基板５４配向方位（度）	７５	７５
位相差補償板１７	位相差補償板	遅相軸方位　（度）	－１５	
		リタデーション（ｎｍ）	２４０	
	位相差補償板	遅相軸方位　（度）	－７５	
		リタデーション（ｎｍ）	２７０	
偏光板１５		透過軸方位　（度）	９０	

[0409] In the liquid crystal display set up as mentioned above, when not impressing voltage to the liquid crystal layer 1, both the reflective display 9 and the transparency display 10 become a dark display. And if voltage is impressed to the liquid crystal layer 1 from this state, the orientation direction will change so that liquid crystal molecule 1a may swerve from the direction (the above-mentioned setup 65-degree direction) where electrode wiring (terminal) of the Kushigata electrode 53 is prolonged. Therefore, in the above-mentioned liquid crystal display, the Ming display is realized by changing the orientation direction of the liquid crystal at the time of voltage impression.
[0410] Thus, the produced display property of the liquid crystal display concerning this example is shown in drawing 22 . In addition, a display property given in drawing 22 is measured by the same method as an example 1, a horizontal axis shows the actual value of applied voltage, and a vertical axis shows lightness (a reflection factor or permeability).
[0411] In drawing 22 , a curve 351 shows the voltage dependency of the reflection factor of the reflective display 9 in the liquid crystal display obtained in the example 12, and a curve 352 shows the voltage dependency of the permeability of the transparency display 10 in the liquid crystal display obtained in the example 12. In addition, although the reflective display 9 has a difference in an optical property with the position on the Kushigata electrode 53, it has indicated the optical property of a typical portion here.
[0412] When the above-mentioned liquid crystal display obtained in the example 12 does not impress voltage so that drawing 22 may show, both the reflective display 9 and the transparency display 10 perform a dark display, and a reflection factor and permeability increase them with impression of voltage with this liquid crystal display. Moreover, both the reflection factor of the reflective display 9 in case applied voltage is 2V, and the permeability of the transparency display 10 were 3%, and the permeability of the transparency display 10 of the reflection factor of the reflective display 9 in case applied voltage is 5V was 38% 35%. Therefore, according to the above-mentioned liquid crystal display, it can be [as opposed to / the transparency display 10 / both] compatible in the lightness and the contrast ratio of the Ming display also to the reflective display 9, and the display excellent in visibility can be realized. Moreover, according to the above-mentioned liquid crystal display, from exceeding the contrast ratio in the reflective display 9, the contrast ratio in the transparency display 10 can raise display grace further, and can perform a good display.
[0413] As mentioned above, according to the above-mentioned example 12, by the conventional installation-performance-specification method, the reflective display was realized in the field on the Kushigata wiring 53 which has not been used for the display, and it checked that the use efficiency of light could obtain a transflective type high liquid

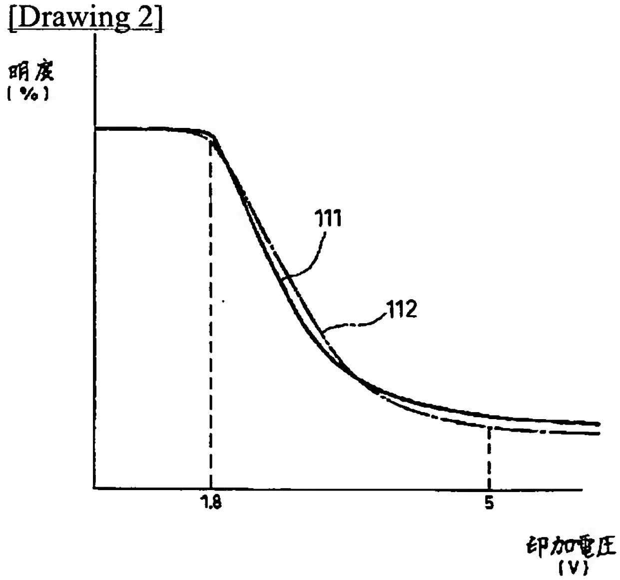
crystal display.
[0414] In the form of this operation, the method of using a ferroelectric liquid crystal display mode besides the method of using a pneumatic liquid crystal like the installation-performance-specification mode mentioned above as a method of realizing liquid crystal orientation mentioned above, the method of using antiferroelectricity liquid crystal display mode, etc. can be used.
[0415] Then, the following examples 13 explain the liquid crystal display which used the ferroelectric liquid crystal display mode for the display as other liquid crystal displays which realize liquid crystal orientation mentioned above.
[0416] [Example 13] In the liquid crystal display shown in an example 1 by this example A surface passivation ferroelectric liquid crystal is used for liquid crystal material. liquid crystal thickness (d) by the transparency display 10 1.4 micrometers, While it sets up so that it may be set to 0.7 micrometers by the reflective display 9, and setting up so that deltan-d of this liquid crystal layer 1 may be set to 130nm by the reflective display 9 and may be set to about 260nm by the transparency display 10

DRAWINGS

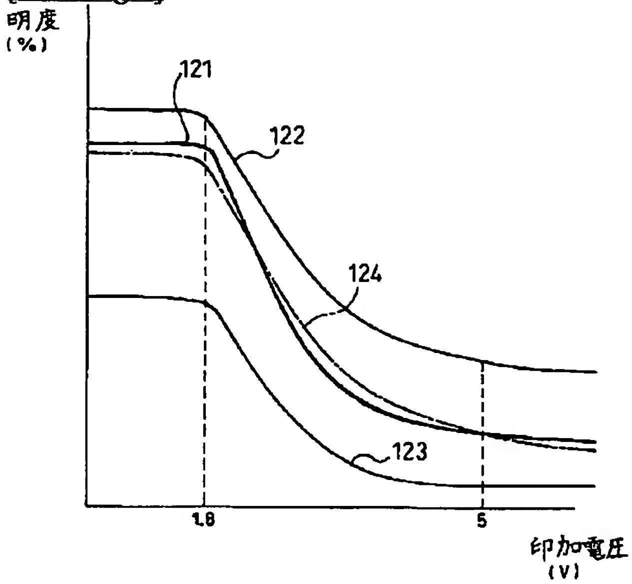
[Drawing 1]



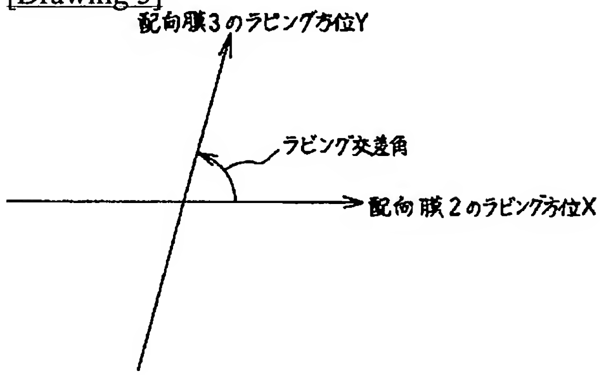
[Drawing 2]



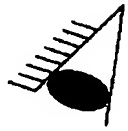
[Drawing 3]

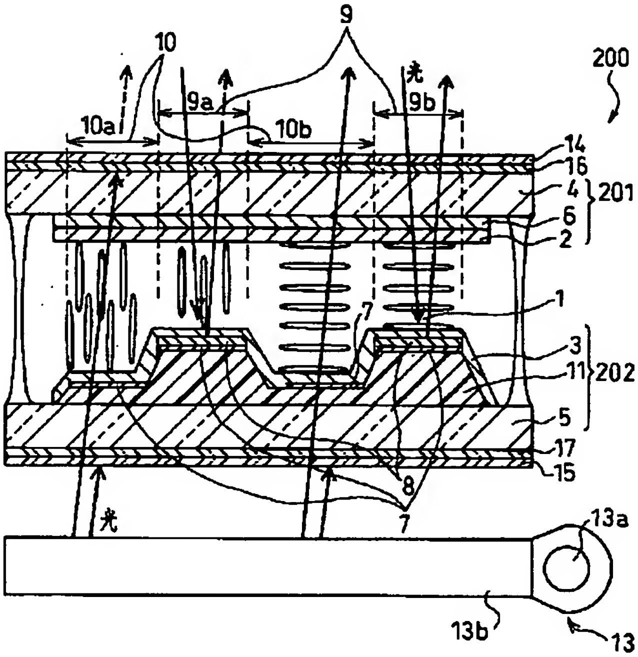


[Drawing 5]

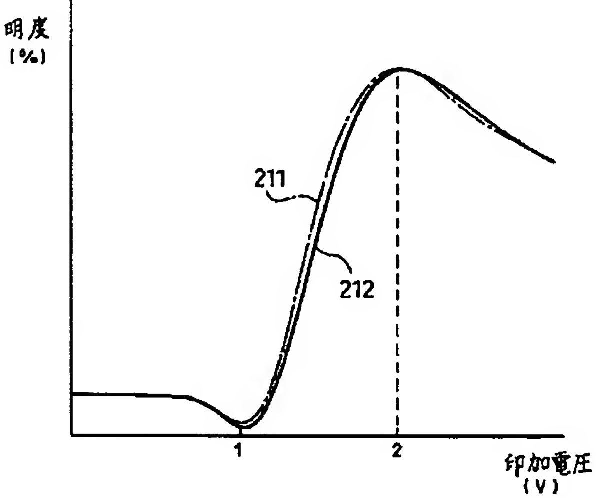


[Drawing 4]

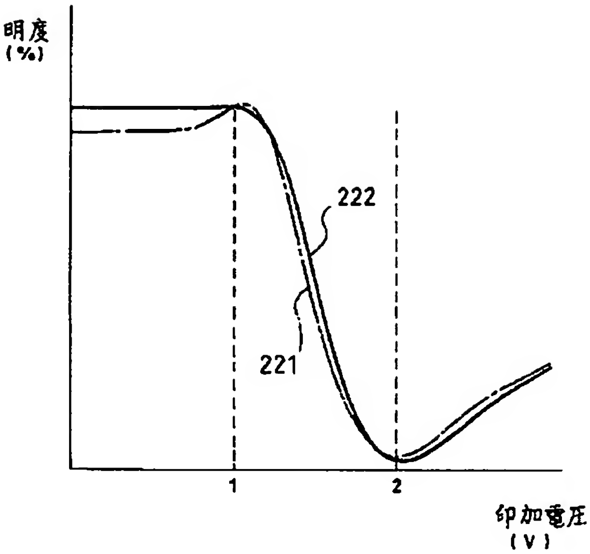




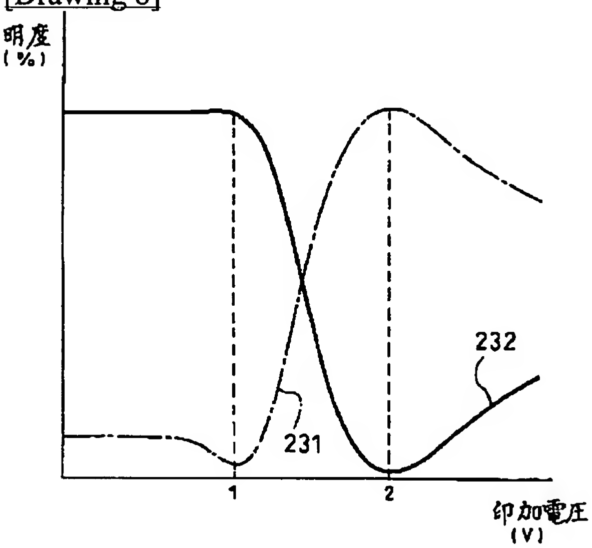
[Drawing 6]



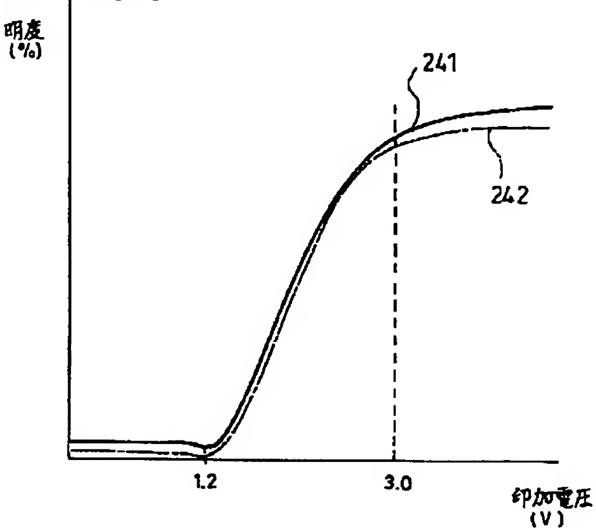
[Drawing 7]



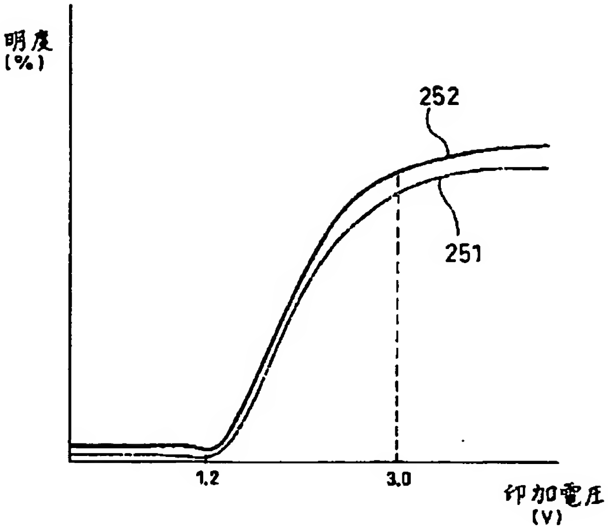
[Drawing 8]



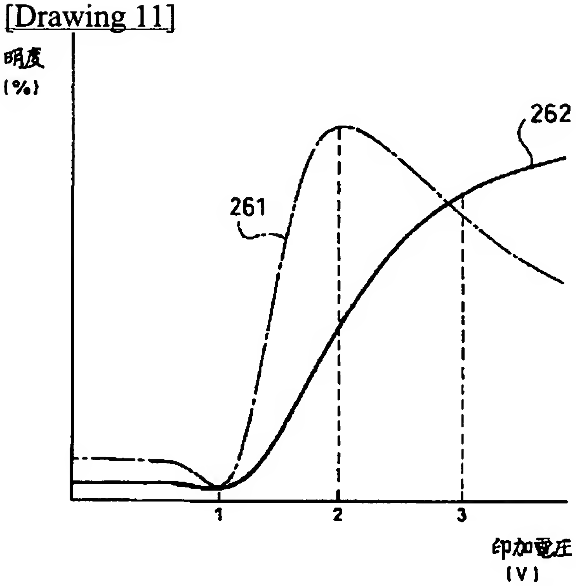
[Drawing 9]



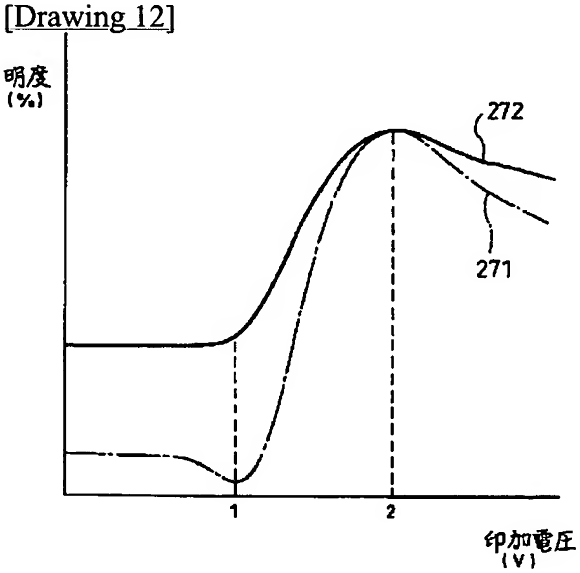
[Drawing 10]



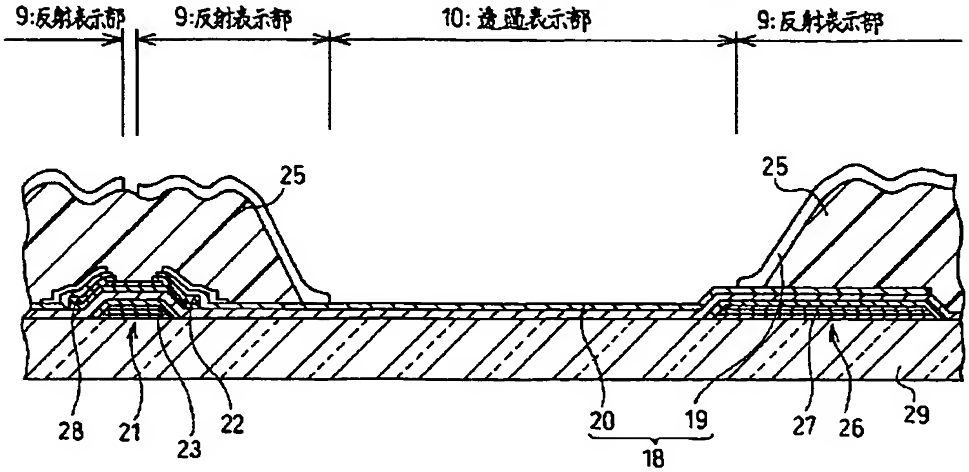
[Drawing 11]



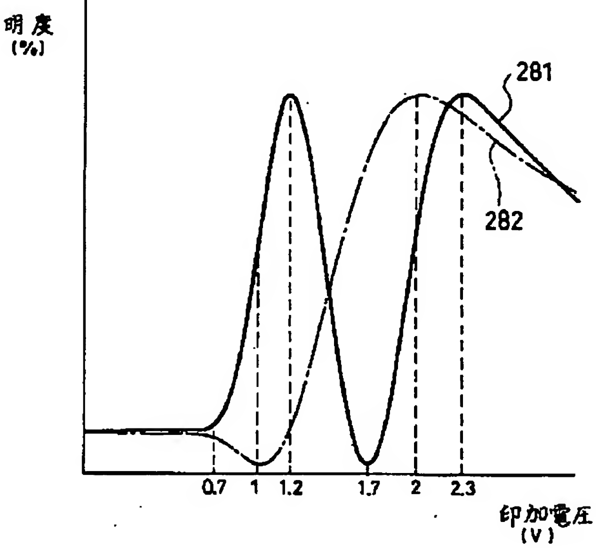
[Drawing 12]



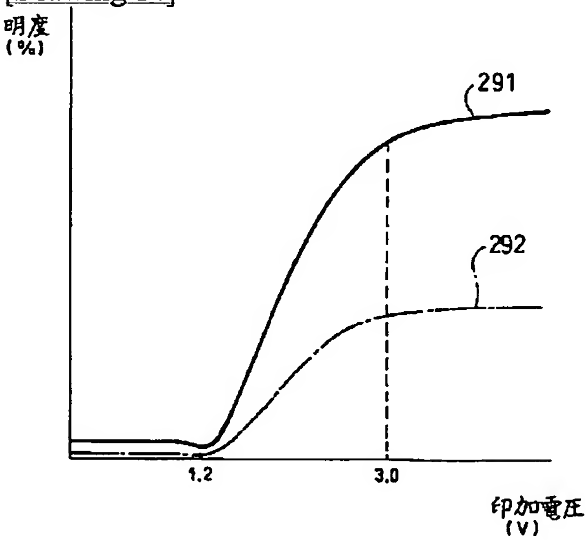
[Drawing 24]



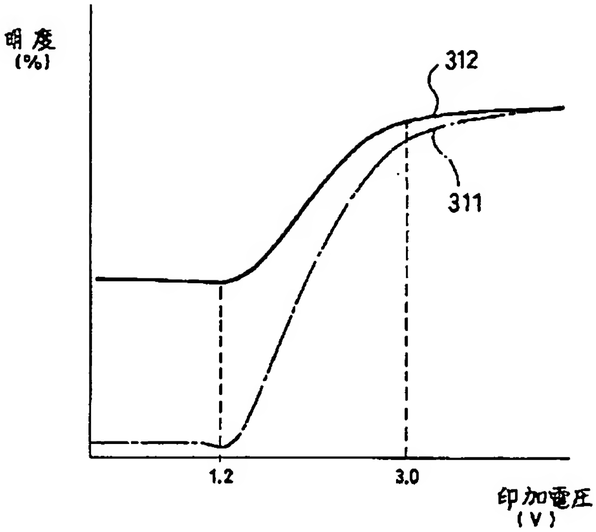
[Drawing 13]



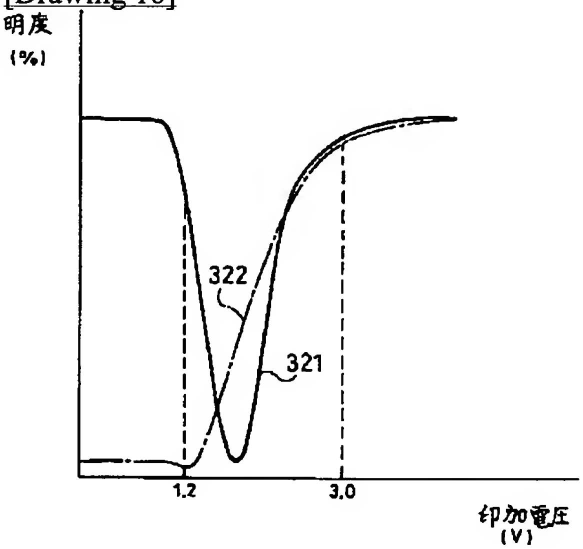
[Drawing 14]



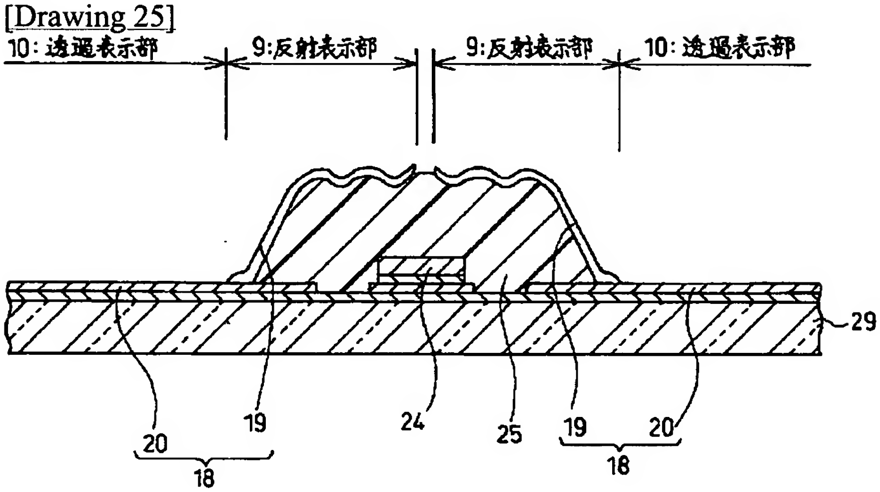
[Drawing 15]



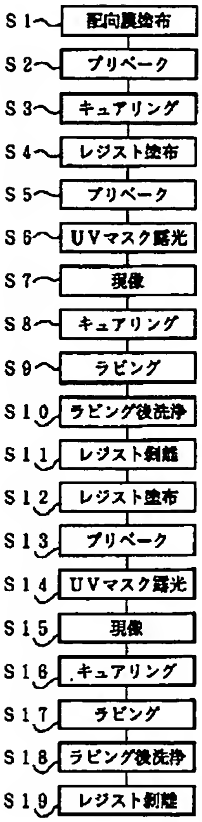
[Drawing 16]



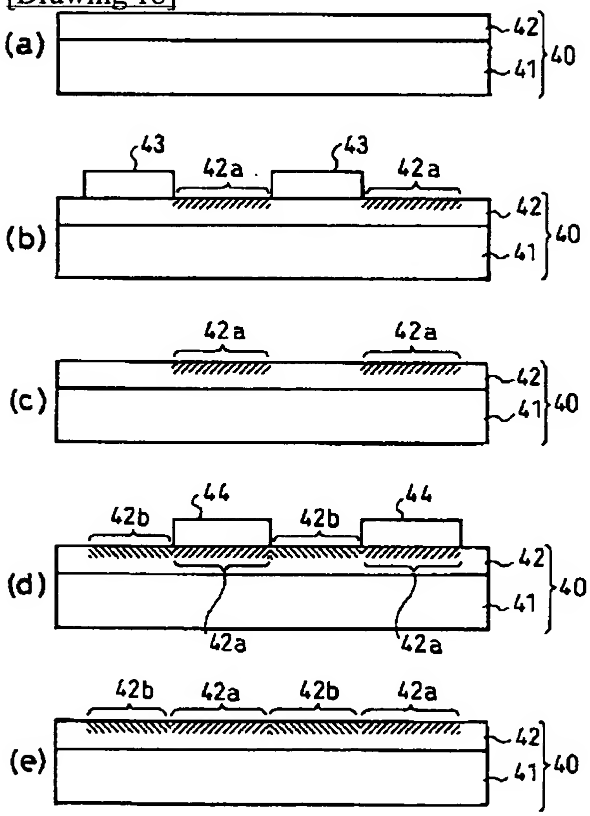
[Drawing 25]



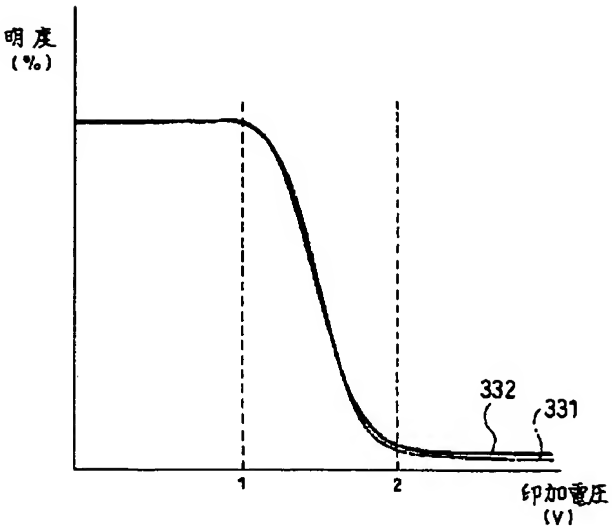
[Drawing 17]



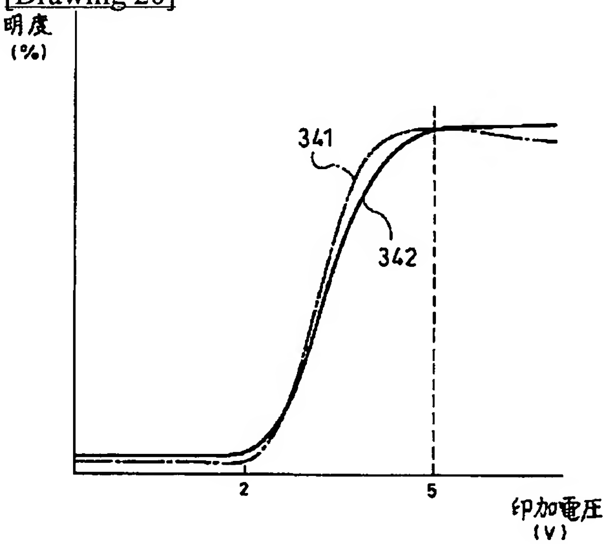
[Drawing 18]



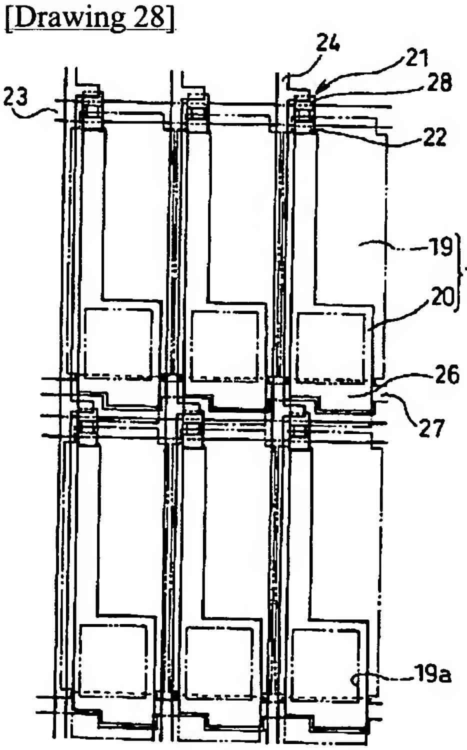
[Drawing 19]



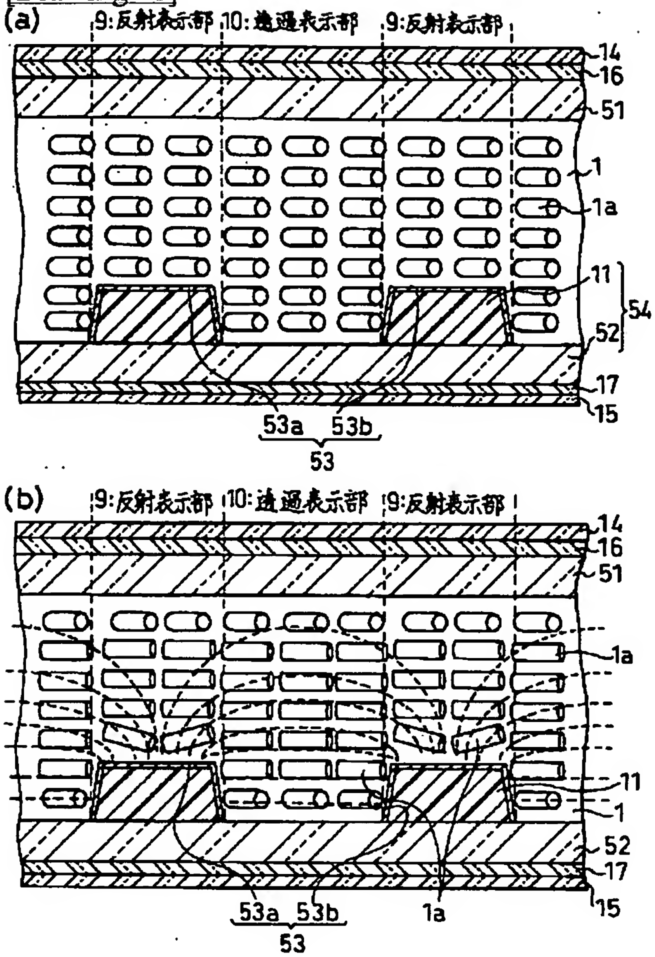
[Drawing 20]



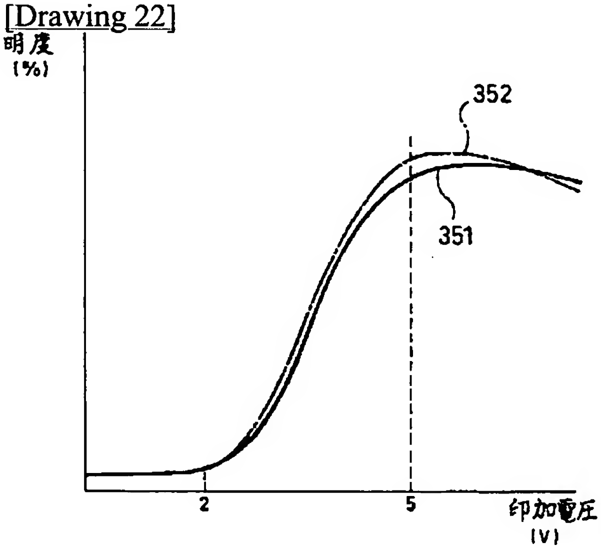
[Drawing 28]



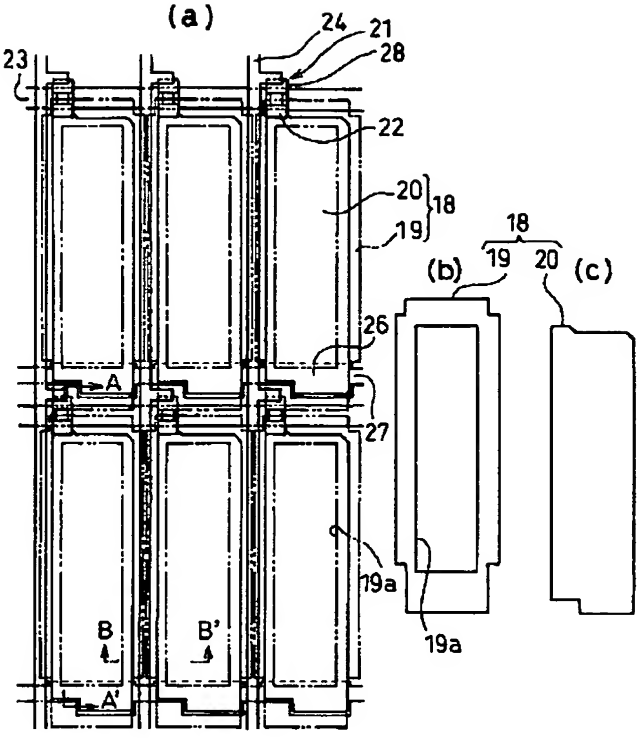
[Drawing 21]



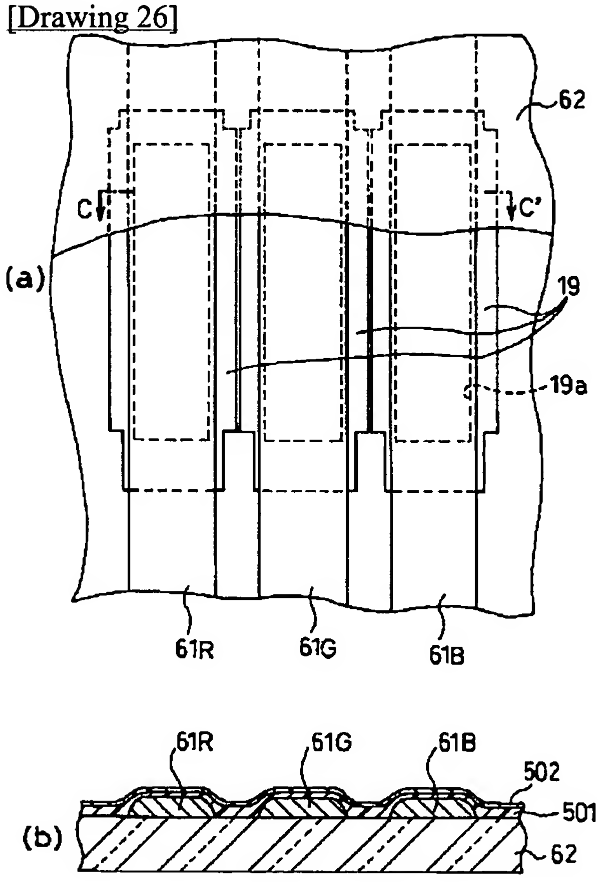
[Drawing 22]



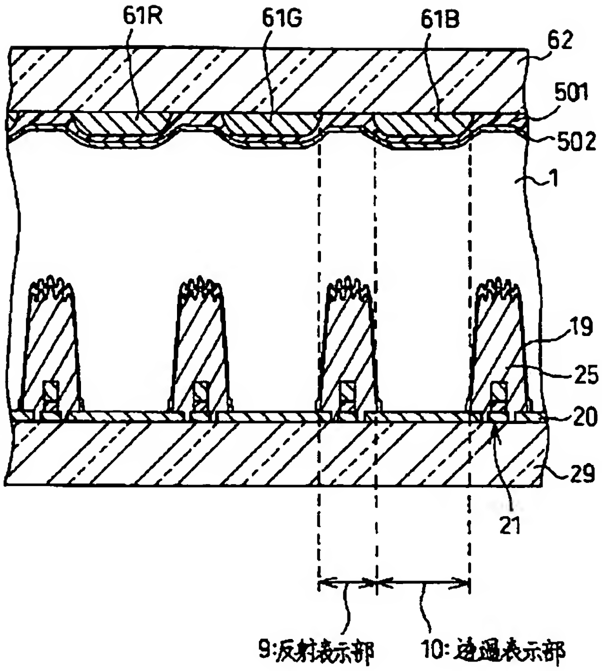
[Drawing 23]



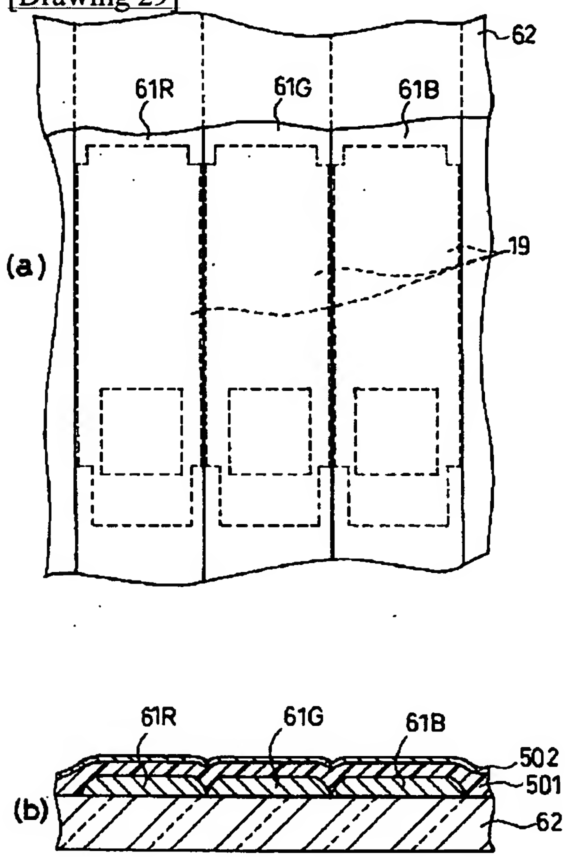
[Drawing 26]



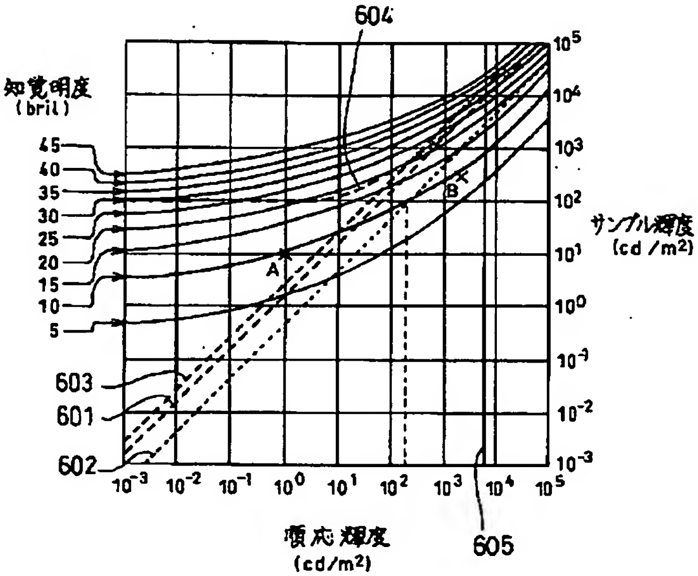
[Drawing 27]



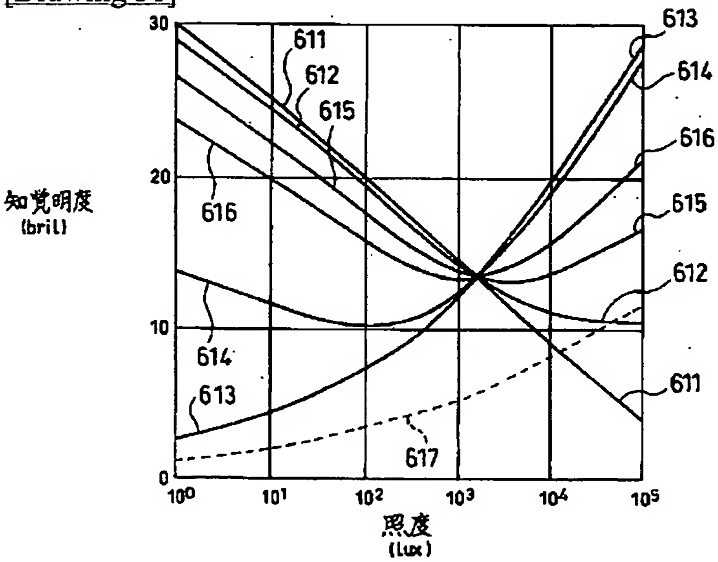
[Drawing 29]



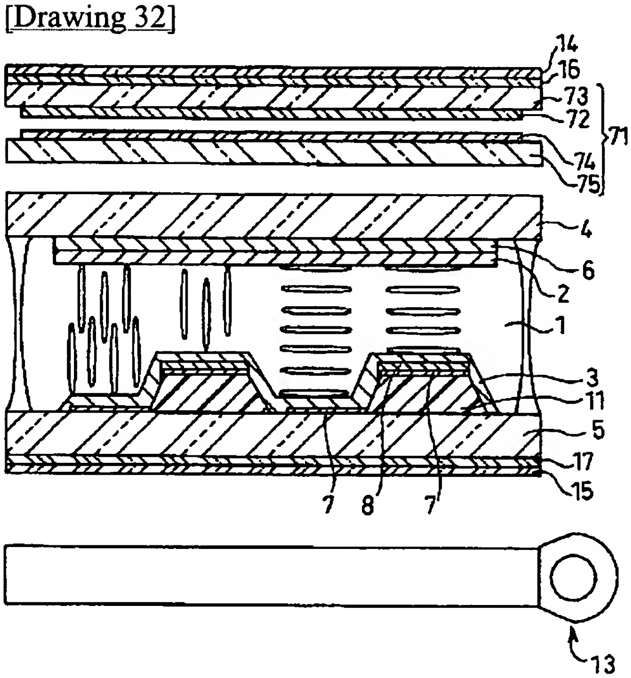
[Drawing 30]



[Drawing 31]



[Drawing 32]



[Translation done.]